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ELECTRICAL WORLD

A consolidation of Electrical World, Electrical Engineer and American Electrician

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THIS INDEX is merely a convenient guide. Many articles will appeal to several reader groups—many will apply to all. News and other departments are of general interest.

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August 25, 1934

L. W. W. MORROW, *Editor*

English Grid Has Its Growing Pains

That interconnection in itself is no assurance of reliable service unless the operation is smoothly co-ordinated by men and by supervisory facilities was demonstrated to the British on July 28 when their southeast England grid was "out" up to two hours. A 70,000- and two 35,000-kw. sets at Battersea station tripped off and apparently the thirteen other stations could not take over the 90,000-kw. load on these units because there was insufficient running capacity to handle the grand total of 300,000 kw. supplying a 12,000-square mile area. As a consequence the system had to be shut down and started again in sections.

We can sympathize with our English cousins. We had a few of these distressing episodes when we were first tying everything together. They don't happen often now, thanks to sectionalization, a highly competent personnel, ample running reserve and super-intelligent protective equipment. We have learned, also, that a vast interconnected system supplied by one or two bulk power stations does not afford service continuity comparable to that afforded by smaller self-sustaining generating areas. Economy also, as well as service continuity, handicaps the development of bulk power grids.

Half a Loaf Better Than None

At least two factories having private plants in the territory served by the Central Illinois Electric & Gas Company purchase power during the summer months when the lack of a heating load gives them a poor heat balance on their boilers; incidentally, this provides standby capacity if needed. While it might be argued that these look like good prospects for year-round purchase of energy, even summer contracts for supply of utility power are not to be sneered at now when development of industrial load is so important.

If utilities can't get the whole loaf in dealing with private plants, why not offer more summer or seasonal contracts where an advantage in heat balance can be shown? It is possible that the opportunity thereby afforded the user to compare private generation with purchase of power will lead to complete changeover quicker than all the powers of logic, accounting, etc. Experience is likely to make a customer sell himself on a change in practice when the most carefully prepared economic analysis may have no effect.

Creating Self-Interest in Utility Problems

Companies which have found little sympathy outside executive circles regarding the increasing burden of taxes and which have been wondering how they can retard or reduce this descending avalanche may be interested in one company's endeavor to make taxes have a personal appeal to employees and indirectly to the public with whom they have many personal contacts—relations or friends.

In the company mentioned, taxes equaled total wages paid. When the president of this company pointed out this fact to employees and showed that for every dollar they earned half had to be confiscated by the company to pay taxes, they began to take an interest in a subject that they had formerly considered an internal company problem remote from them. This self-interest was intensified when they told that taxes were a first lien on the companies' revenues, before employers were paid, and that increase of salaries

and wages is retarded by the tax burden, which if allowed to become larger or still more discriminatory might imperil salaries and wages now paid.

If companies can tie up other problems with the self-interest of their employees, customers and security holders, perhaps they will get some relief that will never be forthcoming so long as they merely cry "wolf." This personalizing of problems handicapping companies will not bring its maximum benefits, however, unless all companies embark on such a program simultaneously, as most conditions imposed upon companies are influenced by national, regional or state administration policies and laws.

Engineers and Washington Bureau Appointments

Probably the greatest defect of the engineer as a participant in the politico-economic world is his honesty and his loyalty to facts, whatever they may prove. If it were not so the engineering profession would be more thoroughly organized for self-aggrandizement. That is why it is so distressing to see so many signs figuratively hung outside the employment offices of the flock of government bureaus which have been springing up—T.V.A., Federal Power Commission and others have as much as said "no utility-minded engineers wanted."

There are practically no utility-minded engineers but there are plenty of "utility" engineers who have attributes of versatility, analytical ability, integrity, a knowledge of light and power engineering, eagerness for facts and the truth, along with all-round ability in getting at them.

In their great fear to keep pure and undefiled these technical governmental staffs there can be seen working in the minds of the commissions the quip, "the more 'tis the more 'taint." Consequently appointments are largely being confined to the untainted. Admittedly there are consulting engineers who know something of electric utility rates and systems, there are a few municipal engineers who have had broad experience with extensive systems and there are professors who study current trends diligently. But the innate complexity of electric systems and their economics is bound to make necessary considerable reliance upon those who have grown up with the problems. If they are excluded it is likely that the staffs will be overbalanced with publicists, impractical theorists and non-organization individualists. The result can easily be utter confusion, out of which can come nothing but more bombast and truckloads of useless questionnaire answers.

The public is paying the bill and it deserves to know the whole truth about our power preparedness and about rates. Nor does any utility executive wish to disguise the facts—quite the contrary. The utility industry should have and does have no desire to pack the staffs with its proponents because its executives know that real engineers regard the facts above security in livelihood. They could not bank on the engineers to do a pro-utility job, whatever that might be. In so far as the government, in staffing the bureaus, shuts out an engineer because of previous experience with private public service enterprises it will be risking futility in trying to dodge "utility." An engineer is a professional man with professional integrity.

A New Approach to Old Prospects

Motors are an old story to the factory man. So is lighting to the storekeeper. Both are pretty old stories to the power company sales department, and as a result the development of industrial and commercial load has lacked the inspiration of novelty. Now comes a fresh approach.

Air conditioning is reopening doors to factories, stores, offices, hotels and public buildings for the salesman who can capitalize the popular appeal of this new idea. It is more than cooling, more than ventilation, because it offers a reason to restudy and refigure the economics of labor saving and the influence of working conditions on production and service. And such a review naturally embraces every application of electricity, every use of light, heat and power and its value to the customer.

There is no smarter strategy in selling than to seize upon some theme of current human interest for reawakening a prospect where a past negotiation has died. Air conditioning is ideal because it is almost universally appealing. It will lead back into the discussion of commercial cooking, for example, where a past decision still bars further argument.

Here is the basis for a reworking of old prospects that promises good returns. For air conditioning is sold by talking the problems of the customer, not the technicalities of the equipment, and this is an open sesame everywhere.

Valid Cost Comparisons in Distribution

What Elements Should Be Considered and Compared and How Shall It Be Done?

By
M. M. SAMUELS
New York

THERE seems to be a consensus that distribution is too expensive. Utility managers, commissioners, governmental utility authorities all appear to be of one opinion—that distribution cost must be lowered. Various attempts at establishing yardsticks are based on the supposition that distribution is too expensive. It is not my purpose to dispute this general supposition. No doubt distribution is expensive. But so is all retailing. A swordfish in the ocean, a shad in the Delaware river, a leopard in the jungle cost nothing, but a swordfish steak or a portion of shad roe at the Waldorf or a leopard skin coat are relatively expensive articles. A farmer gets only a fraction of a cent for a potato, yet we may pay 30 cents for a baked potato at a fine restaurant.

Many data have been published recently on distribution costs, some more and some less interesting, but when one attempts a comparison between any two or more sets of published figures one finds it is as impossible as the classical comparison of Basset Jones between the prices of horses and apples. Now when we state that something is too expensive the statement is meaningless unless we restrict it to definite conditions, and unless we have some figures to show how much cheaper it could be. Good service is bound to be more expensive than poor service, and yet no one has ever suggested a method of comparing distribution costs on the basis of reliability of service. A town may show a greater number of shutdowns than other towns of the same character, and this may be caused either by inadequate construction, improper maintenance or improper operating, or just poor luck. The item of poor luck is one that can be eliminated if the investigation is spread over a period of years. But a balancing of first cost against maintenance cost is certainly necessary for drawing any rational conclusions.

Some time ago the writer attempted to establish a basis for evaluating systems of energy supply to load center on the basis of plant factor, first cost and reliability of service, and arbitrarily established a method for rating this particular type of reliability. It was also shown that "per capita" estimates are more rational than "per meter" estimates.* This was possible for power supply systems because there was an accumulation of data on shutdowns and the problem was otherwise also comparatively simple. Such simple rules of comparison cannot yet be established for distribution systems and perhaps never will be. But the fact remains that if we are to establish sound distribution engineering it is necessary first of all to introduce some rationalization in the great amount of data that is fast accumulating, but is practically useless for lack of such rationalization.

Without attempting to be dogmatic and without any claim that this is the only way, a definite method is here suggested for obtaining data and tabulating them for comparative purposes. First of all, towns should be grouped by population, say up to 5,000, up to 10,000, etc. For each group of towns of approximately equal population a subdivision should be made on the basis of percentage of industrial load or other type of wholesale load. Thus it will be possible to tabulate the data for each group of approximately the same load conditions.

For each town the following data should be made available, preferably for each year from 1920 to date:

1. Population.
2. Area in square miles.
3. Total length of streets in miles.
4. All voltages used for distribution, subdivided into primary and secondary and again subdivided into wholesale and retail.
5. Total capacity of all distribution transformers of each voltage in kva.
6. Over-all total capacity of all distribution transformers of all voltages in kva.
7. Total miles of copper, each voltage, each size, primary and secondary.
8. Over-all total pounds of copper.
9. Total number of poles—exclusive.
10. Total number of poles, joint ownership.
11. Total number of duct feet of underground, including empties.
12. Number of duct feet empty.
13. Total kilowatt-hours sold, each voltage, as recorded by customer's meter.
14. Over-all total kilowatt-hours sold, as recorded by customer's meter.

Commissions, government authorities and engineers of utilities are now occupied with studies of the cost of distribution of electrical energy. The subject is complicated and extremely important. This discussion presents some practical ideas and suggestions from an experienced engineer.

*ELECTRICAL WORLD, *October 31, 1931.*

15. Separately; kilowatt-hours sold, industrial, each voltage; commercial, each voltage; street railway, each voltage; street lighting, each voltage; domestic, each voltage.
16. Rating each customer on the basis of kilowatt-hours (say a 600-watt customer), total customer kilowatt-hours. This rating must be arbitrary and therefore must be accompanied by an explanation of how it is derived. Preferably the estimated average load of an estimated or known annual load curve.
17. On the basis of No. 15, total kilowatt-hours of outages, adding the kilowatt ratings of all customers affected by an outage and multiplying same by the duration of the outage and then adding for the year.
18. Total fixed charges.
19. Total operating charges (exclusive of purchased energy).
20. Total losses in kilowatt-hours.

If such data should become available for a great many towns of each group, the following final data could be obtained for each town of each group, for each year:

Economic characteristics of distribution

1. Kilowatt-hours* per kva. of distribution transformers for each voltage.
2. Over-all kilowatt-hours* per kva. of distribution transformers.
3. Kilowatt-hours per pound of copper, each voltage.
4. Over-all kilowatt-hours per pound of copper.
5. Kilowatt-hours* per pole.
6. Kilowatt-hours* per duct foot.
7. Kilowatt-hours* per mile of street.
8. Kilowatt-hours* per square mile of area.
9. Kilowatt-hours* per capita.
10. Kilowatt-hours shutdown per kilowatt-hour* sold.
11. Fixed charges per kilowatt-hour* sold.
12. Operating charges per kilowatt-hour* sold.
13. Kilowatt-hours losses per kilowatt-hour* sold.

It is realized full well that it will be absolutely impossible to obtain such data in all cases. But in many cases they can be obtained and in many others they can be estimated with reasonable approximation.

A comparison of these thirteen figures for towns the same approximate size and the same approximate load characteristics will no doubt be a revelation which will help establish sound distribution economics.

An attempt to include in this analysis the cost of energy delivered to load centers for distribution would only confuse the issue as it has confused it in the past. A national distribution analysis must assume that this cost is known.

Similarly, the question of demand should be left out for the present. The demand requirements will of course be the cause of some of the results obtained in the above tabulation, even though the demand does not appear as an item. Later additional comparative tabulations can be prepared on the basis of kva. demand. It may, however, be mentioned that the time seems to be ripe for a thorough restating of the whole demand problem. Shall we continue to build generating stations, transmission and distribution systems of a capacity that is only needed twice a day for half an hour or shall we change our whole policy of system planning and establish locally, at peak centers, demand units that are specially designed for short-time operation? Perhaps a dependable Diesel of such characteristics will soon make its appearance on the market and will change the whole aspect of system planning. It would also be of great importance in distribution analysis, especially for large distribution systems. But at present it is well not to attempt too much, it would only delay a clarification of the present distribution muddle.

*As recorded by customer's meters.

If the data outlined are made available, however, it should be possible now to bring about a better understanding of the distribution problem and to formulate even better questions for the future to answer.

Water Pipe Services Thawed for $10

From October 1, 1933, to March 1, 1934, New England accumulated a temperature deficiency of 599 deg. F., of which 319 deg. was charged against February. This unusually severe weather caused such deep frost penetration that about February 10 many water pipe services in Boston became frozen. Speaking before a group of utility engineers H. C. Hamilton, superintendent of the Edison Electric Illuminating Company of Boston's department of standardization and testing, stated that the city's water department appealed for help and as soon as possible three electrical pipe-thawing outfits were mounted on trucks and put at work. The connection of these outfits are shown below:

No. 1—This was made up by mounting a 200-amp.-hr. electric vehicle battery on a 1.5-ton gasoline truck. The battery was arranged in blocks of eight cells each, making 800 amp.-hr. available at 16 volts. It was arranged so that it could be charged at night at 64 volts. The only drawback of this set was the necessity for charging. It was used successfully when thawing

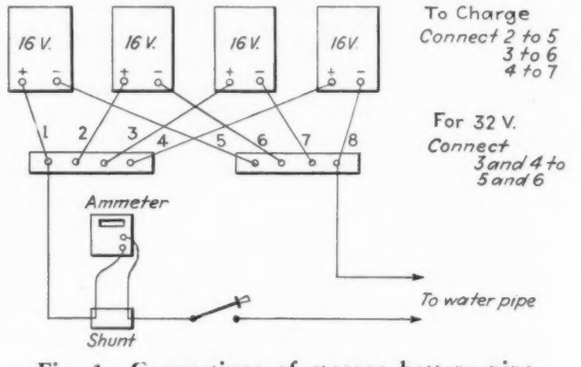


Fig. 1—Connections of storage battery pipe-thawing outfit

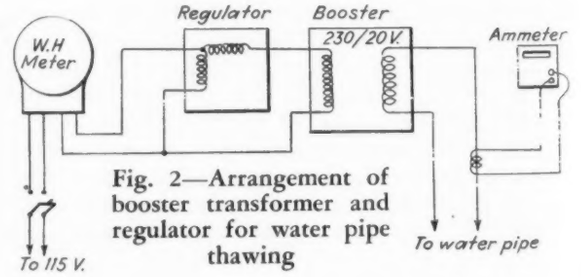


Fig. 2—Arrangement of booster transformer and regulator for water pipe thawing

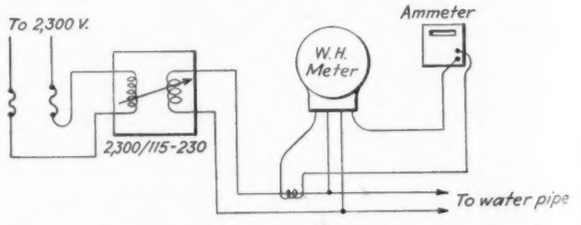


Fig. 3—Use of 36-kva. regulator for pipe thawing

from eight to fifteen ¾-in. services in a twelve to fourteen-hour day without recharging.

In one case a section of 3-in. main was thawed with this battery with an average current of 800 amp. applied for 22 minutes. It was convenient in many cases to be free from procuring an outside source of energy.

No. 2—In this case a 10-kva. booster transformer with a primary winding of 110 or 220 volts and a secondary winding of 20 volts was used with a 2.5-kw. regulator. This equipment was supplied from the 115-volt house service. It was mounted on a 1.5-ton truck with the necessary measuring instruments. As the outfit was energized from house services, it was limited to a primary current of 50 amp. and a corresponding secondary current of 250 amp. Many ¾-in. services were thawed by this equipment, and besides being flexible it had the advantage of smooth regulation of voltage and therefore of current.

No. 3—This consisted of a 36-kva., 2,300 to 230 or 115-volt regulator which was used as a variable voltage transformer excited from one phase of an overhead or underground distribution circuit. It was mounted on a 2.5-ton truck with the proper fuse cutouts and instruments.

The limitations were positions where a distribution circuit could be used to supply the energy. The set was highly useful, however, and was employed mainly on services situated so that a long electrical circuit was needed and current to 400 amp. available at voltages up to 115. Smooth regulation was enjoyed.

Mr. Hamilton said that without question the simplest and the best electrical outfit for water pipe thawing is a direct-current generator having a current capacity of 400 to 500 amp. at 115 volts (with proper field regulation) and driven by a gasoline motor. Some of the newer electrical welding outfits are of this type.

Precautions against fire

It is necessary to disconnect the entrance pipe in the basement of the dwelling and all ground wires must be removed from the water pipe. One end of the circuit is then attached to the entrance pipe in the basement of the dwelling and the other end to a nearby hydrant or entrance valve. If the services to two adjacent dwellings are both frozen it makes an ideal condition as the test loop can be made from one dwelling to the other.

"It is important," said Mr. Hamilton, "to stress disconnecting all ground wires, for it is possible, under certain conditions, especially where the service pipe has became broken due to freezing, to pass heavy currents over the metal coverings of house wiring, heating them at times to such an extent that fires have actually been started.

"Now as to the current to be used in this work. Of course, the greater the current, the quicker thawing takes place. This can best be shown by the following table:

Average Amperes	Average Time in Minutes to Thaw ¾-In. Services
240	16.5
310	13.0
570	3.5

"Since the heat varies as the square of the current, it would seem from the above table that if a current of about 900 amp was used the time would be very short. As a matter of record, in a few instances we did use currents of that magnitude. The time in those cases averaged a little less than one minute.

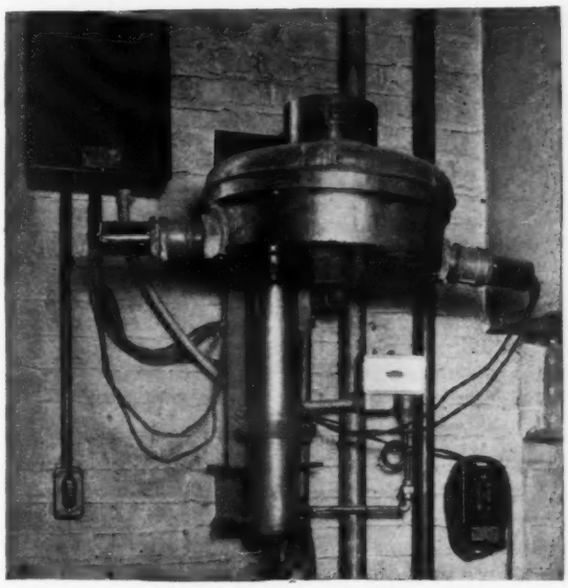
400 amp. maximum advisable

"From our experience, it would seem that a current of approximately 400 amp. would do the work in a few minutes and a minimum amount of danger to the water pipes would obtain. There is some danger in using currents in excess of 400 amp. in unduly heating the joints of the water pipes, which probably have a higher resistance than the pipes themselves. Abnormal heat would be concentrated at the joint and, undoubtedly, would cause some damage. The Superintendent of the Water Department of the city of Boston told me that he fully expected some effects of this sort in years to come after electrical thawing.

"In our work with the city of Boston Water Department we thawed electrically 165 service pipes. We also made 109 calls where pipes were supposed to have been frozen, and where, because of existing conditions, we were unable to complete our work. In a few cases the owner had called in a plumber, who found that the pipes were frozen inside the house; in a few cases the inhabitants were not at home. In the majority of cases, however, connections were made and thawing was attempted, but could not be accomplished due to broken service pipes.

"The average total cost for thawing each service was approximately $10."

Water-Still Improved With Electric Heat



Electrified water-still

Because a fuel-burning water-still used in the plant of the Crane Company in Chicago to supply distilled water for factory truck battery maintenance lacked certain features of control and automatic operation it was decided to electrify it. Holes were cut in diametrically opposite sides of the boiler body and 4,000-watt, 220-volt, immersion type heating units inserted as shown in the illustration. This is a continuous type still with water flowing into it under city pressure. If the water supply should fail for any reason or the water pressure drop below the steam pressure in the still the heating units would not last very long. To guard against this a diaphragm-operated Mercoid switch was placed in the incoming water line. This switch disconnects the heating units when the water pressure fails.

What to Expect of Modern Motor Controls

First Aid to Engineers Who Would Match Controls Against Motors Selected to Perform Certain Duties in Industry

By
GEORGE H. HALL
Consulting Engineer, New York

In two previous discussions* Mr. Hall has stated for industrial readers the fundamental approaches to the twin problems of motorization and control. In this article he has devoted special attention to the types and characteristics of controllers, particularly starting devices, rather than to the functions of control as leading to specifically desired results.

A CONTROLLER, according to N.E.M.A. definition, is a device, or group of devices, which serves to govern, in some predetermined manner, the electric power delivered to the apparatus to which it is connected. When designed solely for starting a motor and bringing it to normal speed in one direction it may be referred to as a starter. If it is used to start the motor in either direction of rotation, or for any other regulating purpose, it is then classed as a controller.

Starters and controllers are designated under three classes, depending upon the method by which they are operated, as follows:

(a) Manual. Those having all of their basic functions performed by hand.
(b) Semi-automatic. Those having a part of their functions performed by hand and a part automatically, usually by electromagnets.
(c) Full automatic. Those having all of their basic functions performed automatically, usually by electromagnets.

In connection with any type of controller, or starter, two basic features should be kept in mind, viz.: low (or under) voltage and overload protection.

Low-voltage protection

A low-voltage *protection* device is one that upon a reduction or failure of the voltage causes and maintains the interruption of power in the main circuit. A low-voltage *release* device operates to interrupt the circuit, but does not maintain this interruption upon the return of the voltage. (N.E.M.A. definitions.)

In the operation of most types of machinery it is desirable that if they are stopped by a voltage failure they cannot resume operation until the proper sequence of starting operations shall have been followed. For this reason the more general practice is to provide control apparatus with low-voltage protection rather than low-voltage release.

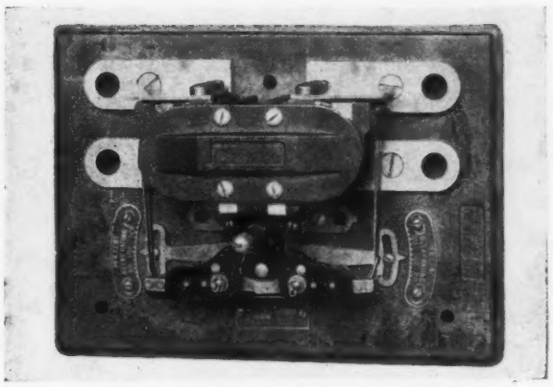
In the construction of controllers the low-voltage protection is usually obtained by the use of a retaining coil which, when magnetized, retains the fingers of the main line control in contact, thus maintaining the circuit. If this coil becomes de-energized, through failure of the voltage, the main contacts at once fall out, or break contact, thus opening the main circuit. To restore the circuit it is then necessary to perform the normal functions of starting.

Overload protection

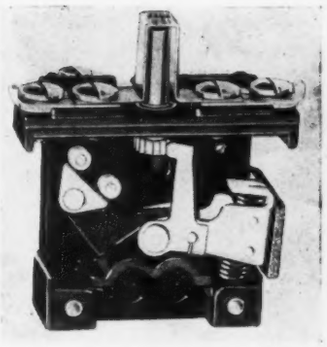
An overload protection device is, as its name implies, one that will open the circuit when subjected to a current sufficiently high or prolonged to cause damage to the motor if continued. As most motors in starting draw a heavy excess of normal running current, it is obvious that the overload device must not operate on instantaneous or comparatively short overcurrents. In operation the time element must be considered and for proper functioning it must be so designed that it will operate only on overloads as they approach the point of danger to the motor.

The principal types of thermal overload devices are those in which the protective "trip" is released by the change in form of a bimetallic strip or by the melting of a film of solder. In either case there is a heating element through which the current passes, and in so doing imparts heat to the strip or to the film of solder. In the former case the heat causes the strip to deflect or curl up, and when this deflection reaches the danger point it releases the trip, which, in turn, causes the main contacts to open and thus shut down the motor. In the film type the heat from the heating coil melts the solder. This causes a ratchet-carrying spindle to rotate and, as the ratchet revolves, it releases the trip. In either case the device cannot be reset until cooling has taken place to a sufficient extent to allow the strip to resume its former position or for the solder to harden sufficiently to again prevent the ratchet from turning.

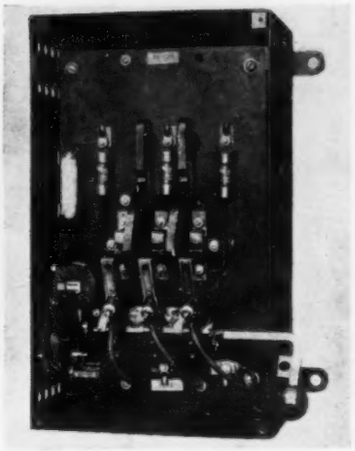
*ELECTRICAL WORLD, *"How to Select the Motor for the Job," June 16, 1934; "Which Motor? Which Control?" July 28, 1934.*



Thermal overload relay employing bimetallic strip
General Electric Company



Thermal overload relay employing solder film
Allen-Bradley Company



Manually operated resistor starter
Cutler-Hammer, Inc.

The operating time of the overload trip corresponds in general to the heating curve of the motor so that, if the proper heating element is used in the protective device, the motor is at all times protected from overloads that might prove injurious. At the same time overloads of a duration not sufficient to damage the motor may be carried without operating the trip.

For squirrel-cage motors

For use with squirrel-cage motors, starters, or controllers, may be either manually or magnetically operated. For the smaller sizes, up to 5 hp., the manual starter may be used satisfactorily, although the magnetic starter is finding general favor. In either case the starter is simply a three-pole switch which is closed by hand or by the operation of a magnet coil, which is in turn energized or de-energized by the closing and opening of a circuit under control of a push-button station. This push-button station may be incorporated in the cover of the starter, as an integral part of the same, or it may be mounted at any remote location so that the motor may be started and stopped from the most convenient operating point. A number of these push-button stations may be used with a single starter, as it is often desirable to start and stop the motor from any one of several points.

The hand starters are usually provided with overload protection, while the magnetic starters have both overload and low-voltage protection. For motors of the low starting current type, running from 5 to 30 hp., the magnetic, across-the-line starters are generally employed.

For motors of the normal starting current type above 5 hp. some type of starter is required that will reduce the impressed voltage, and consequently the inrush of current, until the motor has come up to speed. This may be accomplished by the use of a transformer which reduces the voltage during the starting period to less than normal, or the same purpose may be accomplished by the use of resistance introduced into the starting circuit.

For multi-speed, squirrel-cage motors

The control for motors of the multi-speed type consists essentially of two elements, a pole-setting switch and a main line switch. With a manually operated pole setter the switch is turned to the position that will connect the motor in accordance with the grouping of the poles for the speed desired. This having been accomplished the motor is then started by the main line switch, or starter, the same as any standard single-speed induction motor. Overload and undervoltage protection is provided in the starting switch, while the pole-setting switch is furnished with an interlocking feature which will prevent the starting switch from being closed unless the pole selector is in position, and will also cause the main, or starting switch, to open if the pole changer is moved from one position to another while the motor is running. The pole selector switch is usually in the form of a small drum switch.

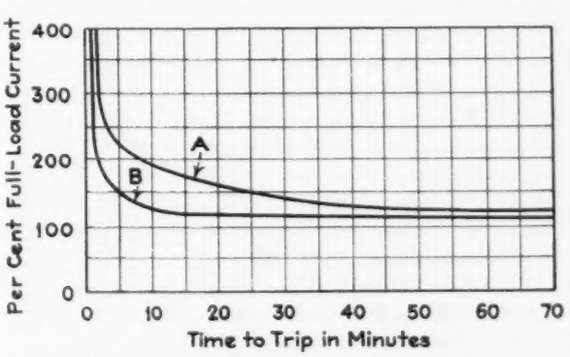
When it is essential that the motor be started only at the low speed the pole changer may be equipped with a "compelling interlock." The function of this feature is to insure that the motor start only when the largest number of poles is in circuit and consequently at the slowest speed. A time element of the device permits

Designation of Resistors Used With Motors

(National Electrical Manufacturers Association)

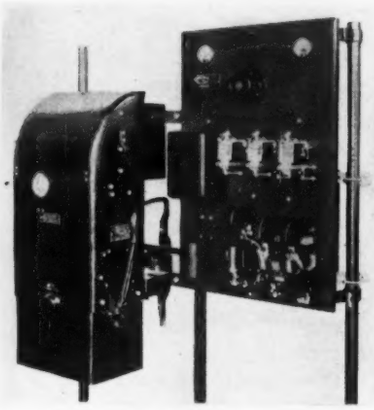
Approx. Per Cent Full-Load Current on the First Point	Periodic Ratings: 15 Sec. Out of 4 Min.	30 Sec. Out of 4 Min.	45 Sec. Out of 4 Min.	1 Min. Out of 4 Min.	1½ Min. Out of 4 Min.	2 Min. Out of 4 Min.	Continuous Duty
25	No. 11	No. 31	No. 41	No. 51	No. 61	No. 71	No. 91
50	No. 12	No. 32	No. 42	No. 52	No. 62	No. 72	No. 92
70	No. 13	No. 33	No. 43	No. 53	No. 63	No. 73	No. 93
100	No. 14	No. 34	No. 44	No. 54	No. 64	No. 74	No. 94
150	No. 15	No. 35	No. 45	No. 55	No. 65	No. 75	No. 95
200 or over	No. 16	No. 36	No. 46	No. 56	No. 66	No. 76	No. 96

Note—15 sec. out of 4 min. means that the resistor will operate at its specified duty not more than a total of 15 seconds during any 4-minute period.

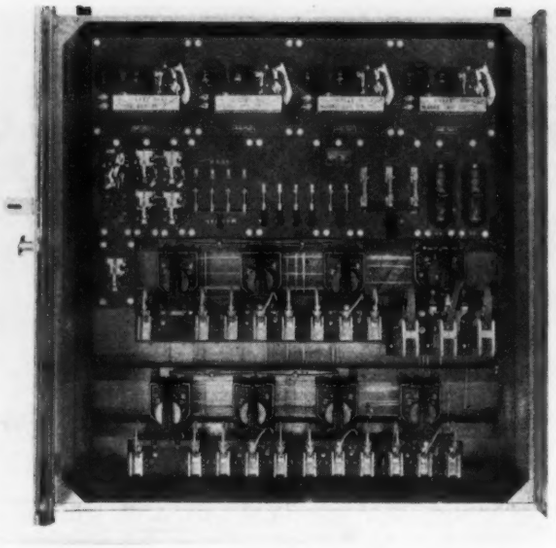


Relation of motor heating to operating curve of thermal relay
(A) motor heating curve, (B) relay tripping time

Manually operated compensator
General Electric Company



Semi-automatic controller for synchronous motors
General Electric Company



Automatic control panel for 75-hp., four-speed squirrel-cage ventilating fan motor
Electric Controller & Manufacturing Company

the grouping to be changed, once the motor is in operation, to any lesser grouping of poles giving any desired higher speed.

Automatic starters for multi-speed motors are provided with push-button operated contactors, which in themselves act as starting switches and pole-selecting switches. Such an automatic starter is in effect a combination of across-the-line starters, each of which, through a suitable arrangement of its connections, throws the motor into circuit with the predetermined pole grouping.

Controls for slip-ring motors

For the control of slip-ring motors three principal elements are involved—a line switch for the control of the primary circuit, a controller for governing the insertion of resistance into the secondary circuit, and a resistor.

The main switch is usually of the magnetic type and may be operated by a push button, a pressure regulator, a high and low limit switch, or any other starting and stopping device.

With the manually operated control equipment the main circuit is closed, while the secondary controller is in such position that the maximum amount of resistance is in the secondary circuit. As the motor comes up to speed the controller handle is moved so as to cut out successively sections of the secondary resistance.

Manually operated controllers for the smaller motors, up to about 25 hp., are generally of the face-plate type, in which the controller handle passes over a series of segments which are, in turn, connected to the different steps of the resistor. For the larger sizes of motors a drum type of controller is more convenient to operate and can be more readily constructed to handle currents of the capacities demanded by motors above 25 hp. ratings.

Drum controllers are usually provided with a primary connection so that the first movement of the drum handle effects a closure of the primary switch while the secondary resistance is all in circuit. Under-voltage and overload protection are provided by the primary switching equipment.

Another feature essential to the proper control of slip-ring motors is an interlock between the primary and secondary elements. This feature is obtained by the use of contacts on the face-plate or drum through which passes the current which energizes the primary switch coil in starting. With the starting lever in the first position current may pass through this interlock to the switch coil so that it will operate. As the handle is moved to the different control points this circuit is opened, and if the primary switch is opened by low voltage, by overload or by intent, it cannot again be closed until the handle of the secondary controller is returned to the starting position and the interlocking circuit re-established.

Automatic control available

Automatic control of slip-ring motors consists of a combination of contactors the operation of which is regulated in a predetermined sequence. Upon depression of the "start" button the primary line switch closes and this is followed by the successive operation of a series of secondary contactors, each of which short-circuits out a portion of the secondary resistance until the final operation effects the complete short circuiting of all resistance. This successive short circuiting by the contactors may be regulated by time relays so that each operation follows its preceding operation at a fixed time, or it may be regulated by the current flow, no step operating until the current controlled by the previous step has reached a predetermined value. The time element control is the type more generally employed.

Controls for slip-ring motors that are to be operated as variable speed machines are of practically the same type as those used for constant speed except that the secondary resistance, instead of being designed to carry the starting current for a limited period, must be capable of carrying the running load continuously. Manual controllers must be so built that the dial arm or drum handle may be left in any of the operating positions. In the case of automatic controllers a multiple push-button station, or a master switch, must be used so as to cause the controller to assume and retain the proper position corresponding to the speed desired.

For use with the automatic controller a push-button station is provided which has a series of buttons, identi-

fied as "slow," "medium," "high," etc. When any one of these buttons is depressed the controller operates until sufficient resistance has been short circuited to permit the motor to attain the speed desired. The remainder of the resistance remains in the secondary circuit as long as motor operation at this speed is required.

Resistors for secondary use

Resistors, or resistances, which are used for the control of secondary current are of several types, each being chosen for mechanical reasons which make it best adapted to the particular conditions of the installation. In all cases the essential purpose is the same; that is, to provide the necessary ohmic resistance to reduce the voltage to the desired point and to carry the amount of current required for the operation of the motor.

In the manufacture of controlling apparatus with which resistors are used it is customary to state the service for which the resistor is suited by the use of the N.E.M.A. classification. Thus a starting resistor may be rated as No. 36, which would indicate that it would carry approximately 200 per cent of full load current on the first point for a period of 30 seconds out of four minutes. Should it be necessary to operate the controller longer than this a resistor of another classification would be employed. If the resistor is to be used for variable-speed work in which the motor is run for continued periods with the resistance in circuit a resistor built for continuous duty rating would be necessary.

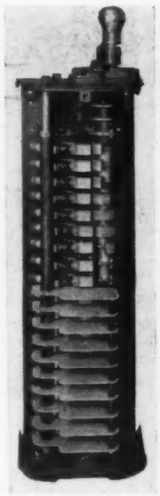
Resistors for speed regulation are further classified under two general groups, depending upon the service they are to perform. Resistors for use with motors delivering constant torque, often called machine type resistors, are designed for service in which the current remains practically constant throughout the entire speed range. Fan duty resistors are designed for use with motors in which the current is approximately proportional to the speed of the motor.

Controls for synchronous motors

Since the synchronous motor is in effect a squirrel-cage motor during the operation of starting any of the various starters for use with squirrel-cage motors may be used as the starting element of the synchronous motor starter. Either by throwing the motor directly across the line, or by reduced voltage starting employing transformers or resistance, the motor is started and operates as an induction motor up to the speed at which the pull-in point is reached.

Four types of synchronous motor starters are available. These are: manually operated for both full-voltage and reduced-voltage starting, and automatically operated for both full- and reduced-voltage starting. The manually operated starters are usually of the semi-automatic type, in that while the actual starting of the motor is performed manually they are built so that the application of the field current is performed automatically by the closing of the field switch at the predetermined pull-in point.

For manually operated starters the full-voltage type employs a switch or circuit breaker by which the main circuit is closed and the motor thrown directly onto the line. If reduced-voltage starting is desired a hand compensator is used. For automatic starters the hand-operated circuit-closing device is replaced by an across-the-line magnetic switch or by an automatic compensator.



Drum type controller for slip-ring motors

Westinghouse Electric & Mfg. Co.

A resettable single-phase motor starter

Overload protection is provided both for the stator windings to protect against undue overloads while running as a synchronous motor and for the rotor windings, to provide against undue overloads in starting.

Full-voltage starting may be successfully employed where full-voltage starting currents do not exceed the limits permitted on the line and where motor and load are such as to stand the sudden application of full-voltage torque. In general, full-voltage starters are best suited to the starting of low-speed motors and reduced voltage starting for high-speed motors. This cannot be considered as a fixed rule as special conditions at times demand the exact reverse. In the selection of a starter for any individual case the conditions under which the motor is to be started should be carefully analyzed both as to load conditions and line limitations.

Full-voltage starters for synchronous motors are generally of the magnetic type so that operation may be accomplished by the use of a "start-stop" push-button station, of which several types are available. For reduced-voltage starting the semi-automatic type provides a simple control in that it combines a manually operated compensator with an automatic device for applying the field excitation when the pull-in point has been reached. In operation it is used the same as a manual controller for a squirrel-cage motor.

Full-automatic reduced-voltage starters are necessarily more expensive than the semi-automatic due to the increased cost of the automatic compensator involved. They are, on the other hand, the most convenient to use as they require no further effort on the part of the operator than that of pressing a "start" button.

For single-phase motors

As single-phase motors are most generally of fractional sizes which do not require under-voltage protection, the common practice is to use a simple switch with which they are thrown directly across the line. The tumbler switch is usually employed since it is contained in a case providing ample wiring space and is most conveniently constructed for mounting. Overload protection can be obtained in connection with this type of switch by the use of a separate thermal protective cut-out. For the manual operation of single-phase motors of the repulsion starting type, in sizes too large to be thrown directly across the line, a resistance type of starter is used.

Electric Enameling Oven After Twelve Years'

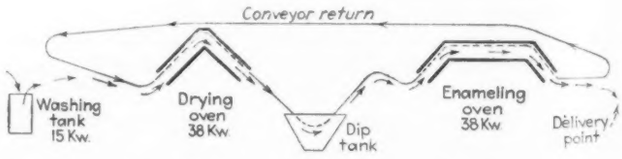
Design of large unit meets conditions of today so well that only minor changes are anticipated when additional facilities are required. An assurance of low obsolescence charges when the electric way is used.

SO LITTLE a prey to obsolescence has an unusually large electric enameling conveyor type oven become in over a decade's service at the factory of the Colt's Patent Fire Arms Manufacturing Company in Hartford, Conn., that when business conditions require an enlargement of these facilities it is expected that little important change will be necessary in the general design of the unit. The electrical division of the Colt company, formerly the Johns-Pratt organization, installed this outfit back in 1922. The unit might, perhaps, be expected to retain its modernity reasonably well if it were a simple box type oven with good insulation, durable heating coils and first-class control equipment. But that an installation 72 ft. long operating with openings into the air of its brick-walled inclosing chamber with outside windows on one side of the room should be able to stand such a test of time as to point the way toward essential duplication as the next step is both interesting and challenging. In all this time the total maintenance expense incurred by the oven and its control equipment has not exceeded $300.

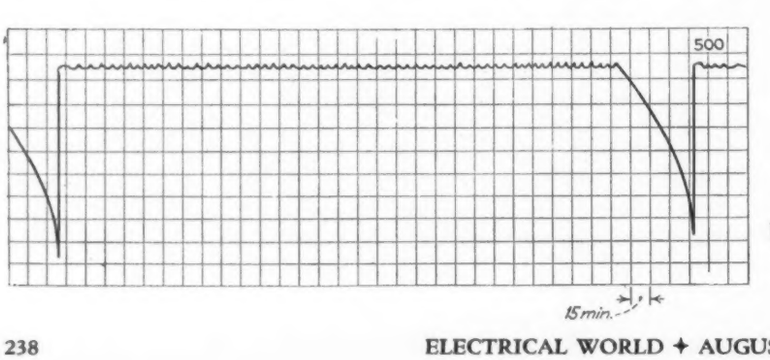
The oven is used in enameling meter and industrial switch boxes of various sizes up to a maximum outside size of 24x24x10 in. It occupies a room about 80 ft. long x 13 ft. wide x 12 ft. high, with a 12-in. wall of brick on the plant side, concrete foundations and automatic fire doors to prevent spread of trouble in case the japanning material should ignite. While this is unlikely, since kerosene is used as a thinner instead of gasoline (the ratio by volume is about six parts japan to one part kerosene), the oven is equipped with a 50-gal. tank of foamite with automatic delivery in case of excessive temperature (180 deg. F.), the tank being piped to deliver extinguisher material into the system in case the controlling fusible link opens.

Switch boxes are brought to the receiving end of the conveyor unit in hand trucks and are dipped into a tank of simmering "Oakite" heated by three 5-kw. General Electric immersion type units and rinsed in a second tank of water for final cleaning before the process starts. This work is done by hand, and at present no advantage is apparent in extending the conveyor to include this dipping as a part of the automatic process. The conveyor, which is driven by a 1-hp., two-phase induction motor, runs at a speed of 1 ft. per minute and extends from end to end of the outfit. The boxes which it carries through the process are hung by hooks on ¾-in. rods 12 in. apart and about 7 ft. long. Experience has shown that if the rods had been placed 14 in. apart the operation would be slightly smoother in view of the 45-deg. angles which the conveyor traverses in going up and down through drying and enameling ovens of the unit.

From the washing tanks the conveyor takes the boxes through an open-air exposure into and through a drying oven 3 ft. 6 in. high. This is equipped with ten 3.8-kw. General Electric heating units which provide a preliminary bake at about 500 deg. F. for about fifteen minutes. From this chamber the boxes are carried through open air downward into a dip tank of 450 gal. capacity, in which the japanning material is automatically circulated by a 2-hp. centrifugal pump with a closed system of piping for repeated cycles of fluid movement. The parts are completely submerged for about 90 seconds in passing through the dip tank. The temperature of the japan

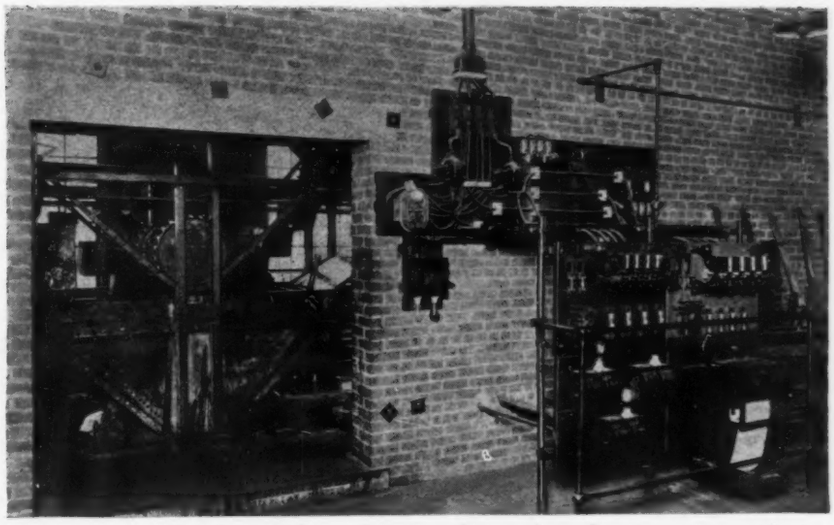


Sketch (not to scale) showing sequence of operations in enameling unit



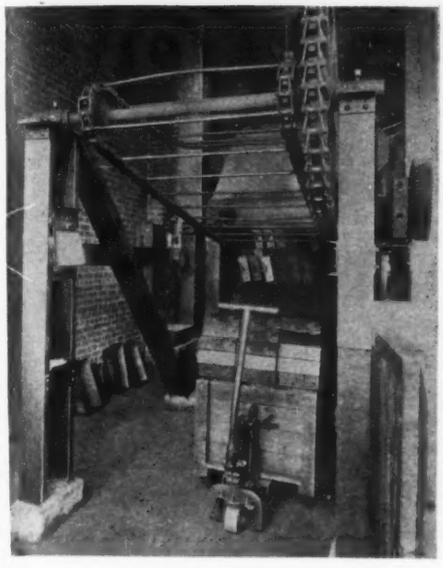
Uniformity of enamel baking temperature control in 8-hour run

Efficient Service



View through fire wall door showing dip tank and conveyor carrying boxes down into the japan and out toward baking oven behind wall

At the right are the service and control panels, with separate watt-hour meter, fuses and relays controlling the energy input into the heating chambers, which are equipped with thermostatic control.



Delivery end of conveyor showing boxes arriving at end of process

is about 45 deg. C., this being maintained by the heat delivered from the parts as they pass through the tank. Passing out of the tank, the boxes again are carried in open air and allowed to drip off the surplus japanning material, which is salvaged as they enter the enameling oven, and returned to the supply system through a tank connected with the pumping equipment. The final step is the baking on of the enamel at a temperature varied according to composition and conditions from 425 to 500 deg. F. With the present kerosene thinner the baking temperature is about 470 deg., and the baking lasts for about 25 minutes, giving a pleasing gloss on the surfaces of the boxes. These vary in thickness from $\frac{1}{32}$ in. to $\frac{1}{8}$ in., according to design. Ten General Electric heating units rated at 3.8 kw. each are provided for the baking, operated two in series at 220 volts. From the baking oven the boxes are removed by hand and packed for delivery to the shipping department. A 16-in. Westinghouse fan motor provides extra cooling air at the outlet of the enamel baking section. The oven is provided with an exhaust fan driven by a 1-hp. motor for use in more quickly removing heat from the bake oven interior in case it is desired to work inside it, but this fan is not ordinarily used in regular service.

The entire process requires about 70 minutes and the connected load of the equipment, including the motors, is about 95 kw. The oven was manufactured by the C.M.S., Inc., predecessor organization of Miller-Somes, Inc., Tarrytown, N. Y., and the control panels with fuses, relays, Leeds & Northrup chart recorder and potentiometer outfit for setting and maintaining the required oven temperatures are located on the plant side of the fire wall. The oven is operated 22 hours a day when business warrants, with eight-hour runs under present conditions. Temperature drops to about 175 deg. at night when not used at that time and approximately an hour is required to bring it up to 470 deg. in the morning. The first cost of the installation was about $19,000. When operated at full capacity of about 205,000 lb. of material passed through per month the complete outfit has consumed 17,060 kw.-hr. On a shorter schedule of 106,353 lb. in one month the energy consumption was 13,220 kw.-hr. Six heating units and two chain links have been replaced in the twelve years' service at a cost not exceeding $100, and the repairs on the control and switching equipment have been about $200.

Danzig to Dissociate Water With Off-Peak Energy

A plant for the production of cheap hydrogen and oxygen by electrolysis at high pressure is now under construction at Danzig, according to a recent report to the Department of Commerce by John H. Bruins, the American Consul there. The plant, the first of its kind, is being constructed by Siemens & Halske of Berlin to utilize off-peak energy of the city electricity works. It is built in accordance with the inventions of Dr. Lawaczeck, Danzig engineer, which permit the bottling of the gases directly from the electrolytic cells at a pressure of 160 atmospheres. Cost of the plant will be $30,000. It is said that it will produce the gases at a cost of 6 cents per cubic meter, compared with the present cost of 32 cents. It is expected that new uses in industry for the gases will be permitted by this reduction of their cost to but 19 per cent of its former value. A second unit is also said to be under construction by the same firm for Japan.

Synchro-ties to Handle Torques of Motor Magnitudes

A Discussion of the Industrial Application of Synchro-ties and the Practically Unlimited Scope for Their Use

By
C. W. DRAKE
Industrial Engineer
Westinghouse Electric & Manufacturing Company,
East Pittsburgh, Pa.

SYNCHRO-TIES have found an amazing variety of applications all the way from merely duplicating meter indications at a distance (one form of telemetering) to the large horsepowers required to control the screwdown of steel mill rolls and to keep a lift bridge level as its ends are elevated. In between are the control of tension in paper-making machines, synchronized feeder regulators and theater stages elevated on an absolutely even keel.

Although units of small size used for metering and indicating angular displacements are operated from a single-phase power supply, the transmission of higher torques and the use of continuously running drives require the use of polyphase machines. These wound-rotor induction motors when connected in synchro-tie arrangement no longer behave as induction motors and it is these new characteristics which must be understood properly to use and apply such machines.

In all cases where any appreciable amount of torque must be transmitted from the transmitter to the receiver unit consideration must be given to the torque, speed and phase displacement characteristics of this combination of wound-rotor induction motors, which these synchro-tie units are in the first and last analysis. If adequate consideration is given to these factors there is no practical limit to the size and variety of applications that can be made of these electrical coupling devices.

The synchro-tie principle—also called Selsyn—was first used only for duplicating meter indications—a matter of small torques. Because industrial engineers appear a bit slow to realize that the principle knows no torque limits, the author was asked to show how to figure the requirements for linking mechanisms of any size in synchronism, or in co-ordinated positions. This article is a fundamental approach to applications of all types.

Before taking up the details behind them, the following features can be enumerated as typical of all synchro-tie installations involving anything but the smallest transfers of power:

1. Units are rated on a torque rather than on a horsepower basis, since they may operate at any speed from zero up.
2. The torque that a machine will carry continuously without injurious heating is reduced at low speeds due to decreased ventilation. This limitation may be removed by the use of forced ventilation.
3. Although varying with individual designs and ratings, most synchro-tie units in the smaller sizes will transmit continuously the normal rated motor torque at speeds of 50 per cent of synchronous or above without reaching unsafe temperatures.
4. The heating and rating will depend on the direction of rotation; that is, whether with or against the rotating field.

Torque and speed characteristics

Synchro-tie units may be operated either with or against the direction of the rotating field.

When operated with the field:

1. The receiver torque is greater than that of the transmitter.
2. The maximum receiver torque is greater than the rated maximum torque of the motor.
3. The receiver and the transmitter torques decrease rapidly toward synchronous speed.
4. Operation at speeds above 50 or 60 per cent of synchronous speed is questionable except for very steady loads.

When operated against the field:

1. The transmitter torque is a maximum.
2. The receiver torque increases with the speed and approaches the value of the transmitter torque.
3. The maximum operating speed is determined primarily by mechanical limitations.
4. The frequency and losses in the rotor increase with the speed and have an effect on the rating.

Regardless of the direction of rotation, the maximum torque values of the receiver and transmitter vary with the speed and also for any speed the maximum values occur at different displacement angles.

Points to consider when making an application

1. Maximum starting and running torques.
2. Continuous running torque or load cycle.
3. Operating speed range.
4. Rate of acceleration and deceleration.
5. Character of load: (a) High or low inertia. (b) High or low friction. (c) Pulsating or steady.

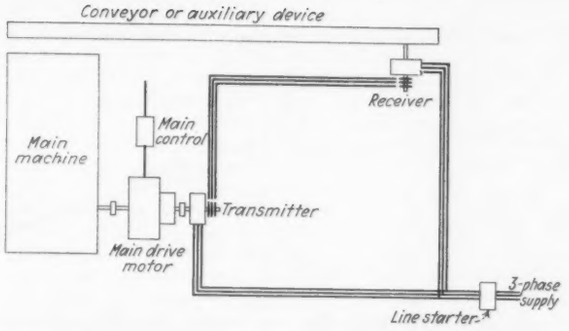


Fig. 1—Multiple synchro-ties can be used to co-ordinate a machine and its conveyor, for example

Two identical wound-rotor motors with their primaries are connected to the same supply circuit and their rotors electrically connected together. Under these conditions for a two-pole motor there is only one relative position of the rotors where the secondary voltages will be equal and opposite so that no current will flow between the rotors. All other positions produce a current and torque which tends to move the rotors to the position of zero voltage. In motors having four or more poles the number of zero points is equal to the number of pairs of poles, consequently if it is essential, as in instruments, that the two machines always synchronize in the same angular position, only a two-pole motor can be used. This, however, is seldom of importance in power drives.

6. Other operating requirements such as the necessity for individual operation, type of control desired, mechanical connection, atmospheric conditions, etc.

7. Type, size and characteristics of machine and control which drive the transmitter.

Fundamentally an application of synchro-tie units involves the same procedure as the making of an ordinary motor application; that is, an analysis of the speed, torque, time characteristics of the driven machine and the choice of a properly rated motor to perform these. The principal difference is that while information is readily available regarding the characteristics of general-purpose induction motors the wide range of operating requirements and the peculiar characteristics of the synchro-tie units make it very difficult to prepare information in advance which will cover all applications. Unless a considerable factor of safety is allowed and the installation made on a somewhat experimental basis it is necessary to check each application to determine if the wound-rotor motors chosen have the correct characteristics for the duty involved. The following information should, however, assist in determining the size and characteristics of wound-rotor induction motors for the more common applications.

Determination of rating

Consider a machine as in Fig. 1, which is driven by a direct-current motor with a speed range from 300 to 900 r.p.m. and in connection with which machine is a conveyor or auxiliary device which must run in synchronism and which requires 2 hp. at 900 r.p.m. with the same torque at lower speeds. Considering the use of a four-pole, 60-cycle wound-rotor motor, the torque to develop 2 hp. at 900 r.p.m. would correspond with 4 hp. at 1,800 r.p.m., but the next larger size standard rating is 5 hp. The full-load torque of a 5-hp., 1,750-r.p.m. motor is 15-lb.-ft., while the torque of 2 hp. at 900 r.p.m. is 11.7 lb.-ft., or approximately 78 per cent of the full-load torque of the 5-hp. motor. From the standpoint of heating only, the 5-hp. motor should be entirely satisfactory at the upper speeds, but if continuous operation at the same torque over the lower speed range, as for instance 300 to 600 r.p.m., is desired, this point should be checked up.

Should this 15-lb.-ft. synchro-tie unit be operated with or against the field? The maximum speed being only 50 per cent of synchronous speed, it is entirely possible to operate with the field, and the high receiver torque as indicated in Fig. 2a is of advantage in overcoming static friction and for rapid acceleration. It should be appreciated at this time that the speed, the acceleration and the deceleration of the receiver are determined by the direct-current motor driving the transmitter, and this should be examined to see what is required. If the auxiliary equipment to be driven by the receiver has a high inertia, it may be impossible for the 15-lb. unit to accelerate it as rapidly as the direct-current motor is accelerated, especially if manual control is used. This, by itself, might call for a larger unit.

Again, if the auxiliary drive has high inertia and low friction (not characteristic of a conveyor) and dynamic braking is used on the direct-current motor, the receiver changes to a transmitter during deceleration. Referring to Fig. 2b, showing the synchro-tie characteristics at one-half speed, it is seen that the transmitter torque is much lower than at zero speed, and if, when braking, the torque required exceeds that available the machines will pull out of step. Tests on conveyors, however, show that the low inertia and high friction cause them to stop so quickly that no difficulty is experienced along these lines even with dynamic braking on the main drive motor.

For drives that must operate in both forward and reverse directions it is evident that consideration must be given to the minimum torque obtainable under any conditions. If reversals are infrequent or not rapid it may be possible to reverse the connections at zero speed so that operation in either direction is obtained with the same rotation of the field.

In Fig. 3 are shown the maximum values of torque developed by the receiver and the transmitter at various speeds and when operated with or against the field. Referring again to Figs. 2a and 2b, it is seen that the maximum torque values of the two units do not occur at the same angular displacement, but in Fig. 3 the maximum values are indicated for a given speed regardless of the angular displacement.

If the transmitter and receiver as shown in Fig. 1 are in synchronism and the transmitter is moved slowly the

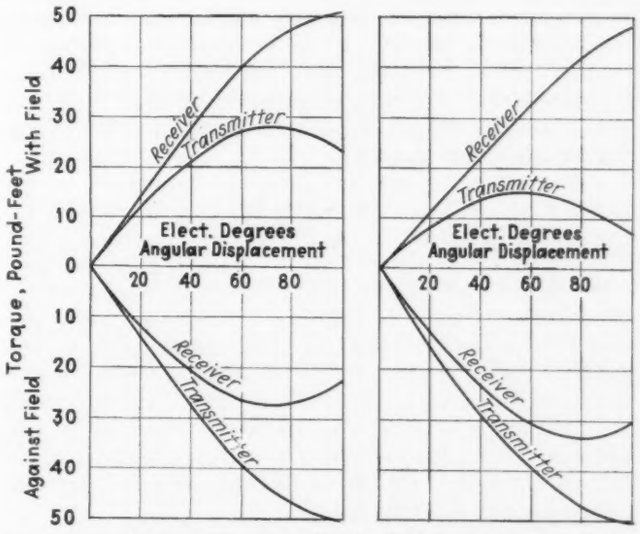


Fig. 2 a and b—Torque-angle displacement characteristics of two 5-hp., four-pole, 60-cycle wound-rotor motors as synchro-ties

Left—At standstill. Right—At 900 r.p.m. (one-half synchronous speed).

angular displacement between the two rotors will increase until the current circulating between the machines and the torque developed is sufficient to start the load connected to the receiver, assuming that it is of ample capacity. The angular displacement is measured in electrical degrees, consequently the displacement in mechanical degrees between the two rotors is equal to the displacement in electrical degrees divided by the number of pairs of poles.

There is a current belief that considerably more power or torque is developed by the receiver than is put into the transmitter and consequently a synchro-tie system can be added to an existing drive without adding much load. Reference to Fig. 2 indicates that when operating with the field the torque of the receiver at high displacement angles is materially greater than that of the transmitter, but at small angles within the range of continuous operation the difference is rather small. Consequently in estimating on such drives it should be considered that the load added to the main drive will be approximately equal to the load on the receiver except for starting or peak conditions. If rotation against the field is employed the receiver torque is less than that of the transmitter and consequently the load on the main drive is proportionately increased. In the first case the deficiency in power is supplied from the a.c. system, while in the last case the excess power generated by the transmitter is delivered to the a.c. system.

Synchronizing, control and protection

Synchro-tie units are synchronized or connected to the alternating-current power supply only when both units are at zero speed. Any angular displacement may exist when connected to the supply, and if three-phase power is applied and the angle is large a high torque is developed. This torque may cause one or both rotors to pass through the zero position at such a speed that if the machine friction is low and the inertia high the restraining or transmitter torque will be exceeded and the rotor instead of swinging back to the zero position will accelerate toward synchronous speed. When the units pull out of step each motor acts as a short circuit for the rotor of the other and each then acts as an ordinary wound-rotor induction motor. If the transmitter is restrained by the load of the main drive the receiver will run up to approximately synchronous speed, but if both machines are free they will run up to some high but indefinite and fluctuating speed.

Although there are in operation numerous drives where three-phase synchronizing has proved satisfactory, the system is subject to the above limitations and consequently the application first of single-phase and then three-phase is recommended as more positive and reliable. With single-phase power applied the receiver and transmitter torques at zero speed are equal and also considerably less than the three-phase torque, so that under usual conditions synchronizing is assured. At other than zero speed, even with single-phase power, the two torques are not equal and cases have arisen where even with single-phase applications special precautions or features were necessary to insure positive synchronizing.

Due to the fact that synchro-tie units may operate at any speed, and in fact may remain stationary with normal three-phase voltage excitation, the most accurate and positive method of protection from excessive temperature is by means of a thermostat suitably located on the units

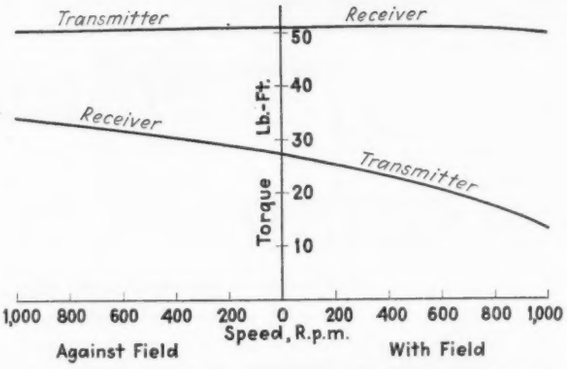
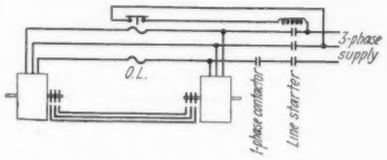


Fig. 3—Maximum torques at various speeds of motors of Fig. 2

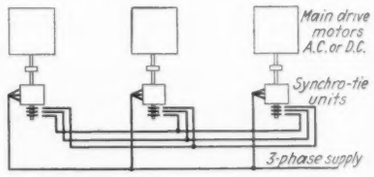


Note the location of switch for single-phase synchronizing and the overload relays for protection.

Fig. 4—Satisfactory scheme for single-phase starting

The primaries and secondaries of the two units are permanently connected three-phase, and single-phase is then applied to the system as a whole when starting. Only a momentary single-phase contact is necessary before the application of three-phase power and various control schemes have been worked out using special push buttons, contactors, etc., in connection with standard line-starters.

Fig. 5 — Multiple drives connected to a similar driving motor give exact speeds



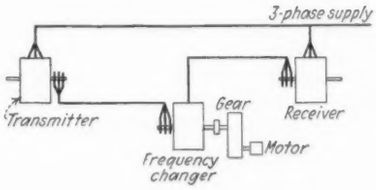


Fig. 6 — Phase advancer brings machines into definite angular relation

Receiver may be run either faster or slower than the transmitter.

themselves. In addition to this thermostatic protection thermal overload relays and fuses are recommended for short-time or short-circuit protection. The ideal location for the protective relays is in the rotor circuit, since the current in this circuit varies with the angular displacement and is a measure of the torque. The current in the primary circuit between the two units consists of the magnetizing and the power current, but at full load or overload conditions is entirely satisfactory as a means of protection. A thermal relay in this location set at approximately the current value of one motor and operating on the line contactor provides suitable protection.

As an extension or development from the fundamental two-unit drive there have been worked out many useful and interesting combinations which, however, do not lend themselves to easy analysis and each requires engineering consideration. Some of the more common of these modifications are as follows, involving the operation of two or more receivers from one transmitter:

Multiple drives having two or more syncho-tie units, each con-

nected to a similar driving motor as shown in Fig. 5. In effect, the synchro-tie system is an electric lineshaft and any unit may become a transmitter or receiver, depending on the characteristics of the main motor. Under ideal speed conditions there would be no interchange of power through the tie units. With such an arrangement the main power is supplied in the customary manner, but synchronous operation of the various parts is assured by the tie system.

The interposing of another wound-rotor unit between the transmittter and receiver, as in Fig. 6, will, if driven, affect the relative position or speed of the two tie units. This phase advancer or frequency changer makes it possible to bring two machines into definite angular relation, and when stationary has no effect on the speed, but does introduce impedance in the circuit, which materially reduces the torque transmitted. If the frequency changer is rotated continuously the speed of the receiver will be increased or decreased, depending on the direction in which the frequency changer is rotated.

Although the torque required to turn the frequency changer is the same as that of the main units, the power is proportional to the speed, and neglecting losses, if it is rotated to give only 10 per cent speed change, the power required will be 10 per cent of that transmitted. Various combinations of speed reducers, variable-speed devices, etc., are required to obtain the low or variable speeds, but for small speed changes the driving units are of proportionately small size.

Electronic Voltage Regulator Stabilizes Battery-Charging Rate

By F. B. DOOLITTLE

Radio Engineer Southern California Edison Company, Ltd.

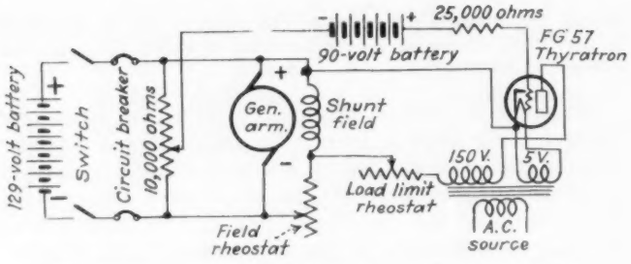
OPERATING practice in regard to station batteries at the substations and generating plants of Southern California Edison Company, Ltd., now calls for a floating charge which maintains the battery voltage at 2.15 volts per cell. At many of the stations the motor-generators for charging the batteries are much larger than normally required to supply the floating charge in order that they may be capable of bringing the battery up in a reasonable time after a period of abnormal demand or an outage of the charging equipment. Consequently, under the normal floating charge condition, the battery-charging generator is operating so low on its saturation curve that the charging rate is unstable, requiring frequent adjustment of the field rheostat by the station operator. Various makeshifts have been used at some stations such as a vernier rheostat connected to the generator field rheostat or resistance in series with the generator armature which permits the generator to operate at a higher voltage at the expense of some energy loss.

To overcome this difficulty a very simple and inexpensive electronic voltage regulator was developed and has operated successfully for several weeks at one substation. The regulator employs a hot-cathode, grid-controlled, mercury-vapor rectifier tube to supply additional excitation to the generator field when the voltage is below normal. The characteristics of this tube are such that when the grid voltage is more positive, with respect to the cathode, than a definite trigger voltage, current will flow in the plate circuit so long as the plate is positive with respect to the cathode. By supplying the plate with alternating current it is made alternately positive and negative with respect to the cathode and, therefore, stops the current flow each cycle during the time that the plate voltage is negative. Whether or not the current is started when the plate becomes positive on the next half cycle depends on the grid voltage at that instant.

The grid voltage required to trigger the tube used is about two volts negative with respect to the cathode, so that normally the grid is negative and draws no current from the grid battery. However, if the generator voltage drops considerably the grid will become positive and will draw current from the grid battery, the amount of current being limited to a low value by the 25,000-ohm grid resistor. In regular service shelf life should be realized from the dry cell grid battery.

Current for the plate circuit of the rectifier tube is supplied by a 150-volt winding on a transformer which is supplied from the same source as the motor which drives the generator. During the half cycles when the tube is conducting, current flows from the 150-volt transformer winding through the tube from the plate to the cathode and thence to the positive end of the shunt field, where the current divides, part going through the field, tending to increase the generator excitation, and part through the generator load circuit and the field rheostat back to the load-limiting rheostat and the transformer. Thus only a portion of the total rectifier current is available to increase the generator excitation, the proportion being determined by the relative resistances of the shunt field and of the field rheostat at the no-load or floating-charge setting. On the 6-kw., 150-volt machine to which this regulator was applied it was found that increasing the average field current 0.2 amp. increased the charging rate of the machine from 8 amp. floating charge to 40 amp., which is full load on the machine. The F.G.57 thyratron tube used has an average anode current rating of 2.5 amp., so that as much as 2.3 amp. of the rectified current could flow through the load and field rheostat and still leave the 0.2 amp. required to obtain the desired regulation of the generator. As a matter of fact, the resistance of the field winding and of the field rheostat is about the same on this particular machine for the floating charge setting of 8 amp. and 129 volts and, consequently, a smaller tube capable of carry-

New device eliminates field adjustment and stabilizes voltage on low saturation points, thus relegating to the discard one of the familiar and sometimes forgotten chores in substation operation.



Electronic voltage regulator for battery-charging motor-generator

It will be observed that the voltage on the grid with respect to the cathode is the algebraic sum of two components; starting with the cathode which is connected to the generator positive, a negative component of grid voltage is first obtained consisting of the drop across a portion of the 10,000-ohm potentiometer connected across the generator output. This component is variable, becoming larger as the generator voltage increases. To this negative component is added a definite positive component consisting of the voltage of a grid battery, which in this case consists of 90 volts of dry cell radio B batteries. Thus when the generator voltage is low the grid becomes more positive from the grid battery and the rectifier tube passes current on the positive half cycles, while when the generator voltage is high the grid becomes more negative, due to the voltage taken from the potentiometer, and thus prevents the flow of current through the rectifier tube.

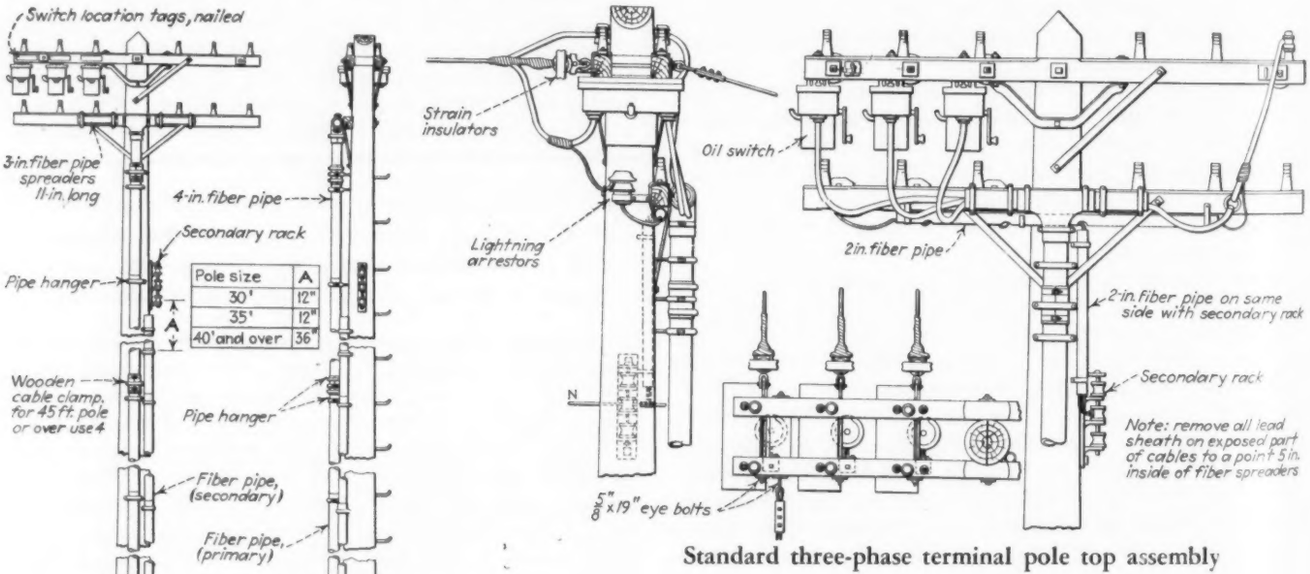
ing but 0.4 amp. would accomplish the desired regulation. The load-limit rheostat is included in the rectifier circuit in order to limit either the rectifier current to a safe value for the tube or to limit the excitation of the generator to a safe load for the machine.

In operation this regulator possesses several advantages over more complicated types. Failure of the regulator to function leaves the generator operating self-excited at the load setting determined by the field rheostat. Failure of the a.c. source supplying the motor and the regulator leaves the generator self-excited so that it cannot run away on energy drawn from the battery if the reverse current attachment on the circuit breaker fails to function. With the potentiometer set to hold 129 volts the regulator functions so perfectly that deviations from this voltage cannot be detected on the switchboard voltmeter when any load within the generator rating is thrown on the station battery circuit, the generator immediately picking up current equivalent to that taken by the additional load. In case several large circuit breakers are closed in succession, the battery voltage is pulled down and the generator picks up full load, maintaining it until the battery voltage is again normal. The constant load on the battery at this station is 8 amp. The field rheostat of the generator is set to charge about 6 amp. without the regulator, so that normally the regulator supplies a small part of the generator excitation. Observation of the tube indicates that it conducts half cycles of current intermittently.

Standard Three-Phase Terminal Poles

Terminal pole tops and standpipes on the Brooklyn Edison Company 4-kv. system minimize costs and offer a desirable degree of standardization. At locations where underground cables are connected to overhead single-conductor, No. 4/0 rubber-insulated, lead-covered cables are pulled from the manhole to the top of the pole in standpipes of 4-in. conduit. These cables are connected to single-conductor, rubber-insulated, braid-covered leads from the oil switches on the pole. Oil switches are always installed at these locations.

The cables are connected by a twisted splice insulated with rubber tape and protected by friction tape and asphaltum paint. The rubber tape extends 2 in. over the lead sheath, which is removed on all exposed parts of cables to a point 5 in. inside of fiber spreaders. This type of installation avoids the use of potheads. Cables in the standpipe are supported by wooden clamps. These installations have been satisfactory in operation.



Location of primary and secondary standpipes with both on one pole

Standard three-phase terminal pole top assembly

A Substation Gets Ready for the Coming Range Load

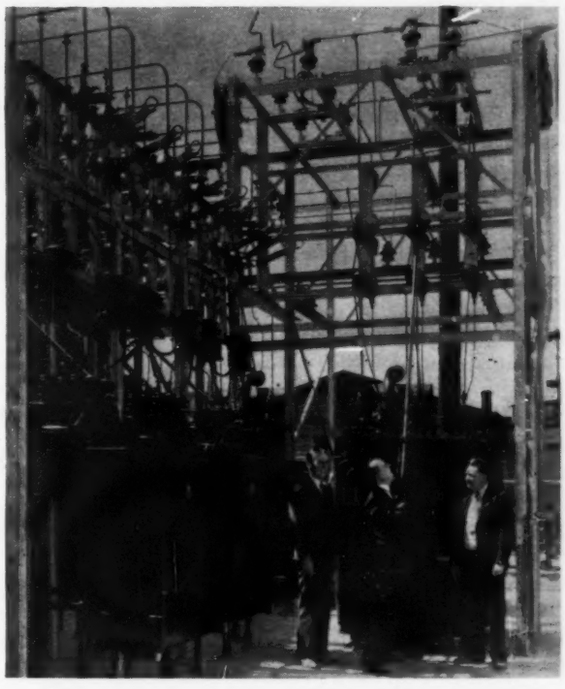
Florida Municipal Designs Compact Station on Limited Area to Anticipate a Promotional Drive for Load

By M. W. BROWN
General Superintendent, Orlando (Fla.) Utilities Commission

HAVING its power plant and its interconnection with the Florida Public Service Company both on the north side of the city and a primary distribution voltage of only 2,300, the Orlando Utilities Commission experienced undesirable voltage regulation in the southern section of the city. Rather than spend the amount of money which would have been required to convert the entire primary system to a higher voltage, we chose to improve service in this section by erecting an unattended substation at its load center and feeding it at 12,000 volts from a new substation at the power house. This change, coupled with strengthening of secondary circuits and house services, where warranted, has removed cause for voltage complaints, which might have increased rapidly with the rapid extension of electric-range and water-heater service, now being stimulated by our rental plan* and inducement rates.

The step-down substation has some features, it is believed, not common to most substations. Load conditions dictated its location in a business section where there was already a substation site which did not provide sufficient space for the spread-out arrangement usually associated with outdoor stations. The site, measuring about 25x42 ft., is between a railroad siding and a 17x21-ft. brick housing on an alley and adjoins brick buildings on either side. Outdoor construction was employed that accommodates, in a little over 1,000 sq.ft., the following equipment: Three single-phase, 12,000/2,400-volt radiator-cooled conservator-type transformers (General Electric), connected delta-delta for a total rating of 2,500 kva.; a three-phase step-type voltage regulator (Westinghouse) on the 12,000-volt supply, and six 400-amp. automatic-reclosing breakers (Westinghouse) on the 2,300-volt, 200-amp. feeders. There is space for two more switch positions and the 2,500-kva. bank of transformers could be replaced with a 4,500-kva. bank if needed.

2½ kva. per square foot attained in a 2,400-volt distribution station. There is room for 2,000 more kva. and plenty of space for maintenance and shifting of equipment. All spacings are for 7,500 volts. Straight-line vertical arrangement is the distinctive feature of the station.



Limited space met by unusual substation design

Although this site may seem small for so much equipment, and the construction above the feeder breakers may appear cramped, it should be pointed out that 7,500-volt clearances are provided for all the 2,300-volt equipment and there is plenty of room for maintenance. For example, the transformers can be moved back from their operating position against the rear fence for minor repairs or taken out through gates in the fence to railroad cars on the adjacent siding for major repairs. The open space on each side of the parallel rows of feeder breakers affords ample room for working on any assembly of breakers and the associated automatic reclosing equipment. The space on one side is wide enough for a truck to back in from the alley to load or unload equipment and also provides room to move out the regulator if that is ever necessary.

Two 12,000-volt underground circuits from the power-

*See "Trial Ranges in Orlando," ELECTRICAL WORLD, *August 4, page 142.*

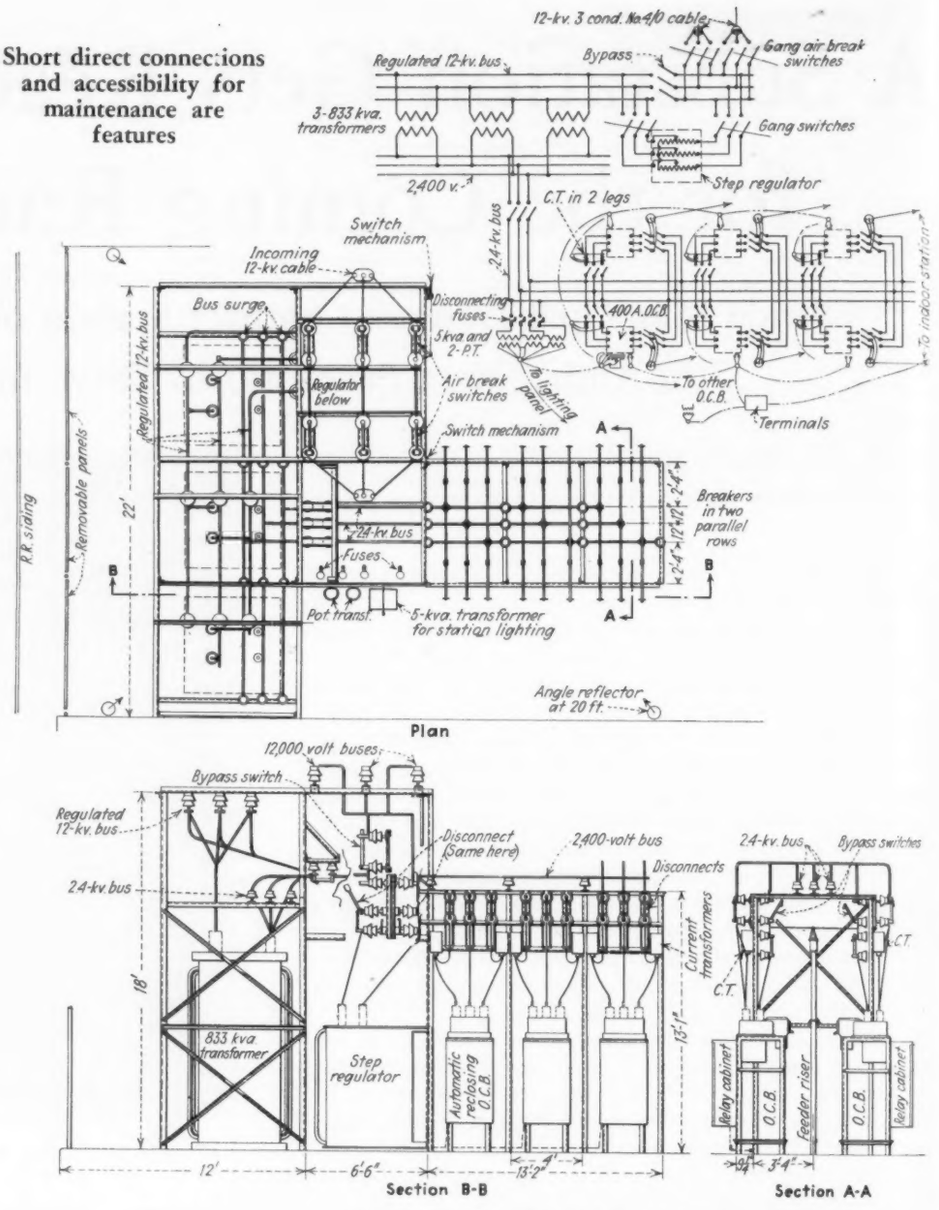
house substation rise in conduit at each end of the regulator to the 12,000-volt bus, where air-break switches (Southern States Equipment Company) may connect either or both circuits to the bus. This bus extends over the top of the regulator. Between the two are back-to-back-mounted gang-operated disconnects (S.S.E.C.) which serve the double purpose of disconnecting and by-passing the regulator so the transformers may be fed with regulated voltage or directly from the bus. No circuit breakers are inserted between the transformers and incoming 12,000-volt supply, because the transformers, regulator and cables are considered a unit which is protected by circuit breakers at the power-house substation.

The regulator has its associated relays and contactors mounted in a cabinet on the front. To prevent unnecessary operation of the regulator tap-changing mechanism, with extreme load fluctuations, such as caused by elevators, time-delay relays are inserted in the voltage-raising-and-lowering contactor circuits. They are adjustable, but are now set at 90 seconds. A cycle-counter on the regulator mechanism records the number of times it operates, so if there is excessive operation that would unduly increase maintenance, the time delay can be lengthened. Every time the mechanism operates a contact-making voltmeter at the power house is actuated so a warning is obtained if the wrong voltage is being maintained. The regulator can be operated either manually or automatically. Across the terminals of the regulator are gaps and surge arresters to protect the windings.

Although the incoming and outgoing circuits in this substation are all underground, surge arresters are connected with the buses. These arrangements have been used before to give satisfactory operation.

It is the arrangement of the 2,300-volt feeder equipment which is rather unusual, as may be noted from the accompanying illustration. The circuit breakers are arranged in two parallel rows. Above them are the 2,300-volt bus, breaker disconnects and by-pass switches, which are mounted back to back and hook operated. The disconnects on the outside of the switch structure are connected between the bus and breakers. Those on the inside are double-throw units employed to by-pass the breakers. Their hinges connect with the outgoing feeders, their upper jaws with the bus and their lower jaws with the breakers. This simple combination per-

Short direct connections and accessibility for maintenance are features



Itemized Cost of 2,500-Kva., Six-Feeder Substation

Between this outdoor substation and the alley is a small brick building, previously mentioned, which houses transformers supplying 110/220-volt light and power service in the local underground district. They are controlled from one of the outdoor switch positions. There are two single-phase, 2,400/220-volt units connected open delta and rated at 200 kva. and two three-phase, 2,400/110-volt units rated at 150 kva. Ventilation is provided by two louvers at the floor level and two stacks in the ceiling. The transformers are not included in the cost of the substation given, because they were in the old substation.

Equipment and material		$40,118
Labor*		2,000
Overhead		4,220
Total		$46,338
Cost per kva		$18.54
Partial list of equipment:		
3 833-kva. transformers	$6,000	
1 2,500-kva. step regulator	5,250	
6 400 amp. oil-circuit breakers	8,163	
Supervisory control	680	
54 s.p.s.t. 400-amp. disconnects	1,134	
Property	6,600	
Transformers and secondary equipment	6,000	
		$33,827

*C.W.A. labor under company supervision was employed at 40 cents, 60 cents and $1 per hour, depending on nature of work, but very little of latter.

mits inspection or maintenance of the breakers without interrupting the circuit. The feeder cables rise in a single row of conduit between the parallel rows of breakers, their pothead terminals on a level with the hinges of the by-pass switches.

With this construction all connections are short and direct, the feeder risers lead directly to the ducts connecting with the street and all equipment is accessible for maintenance and operation.

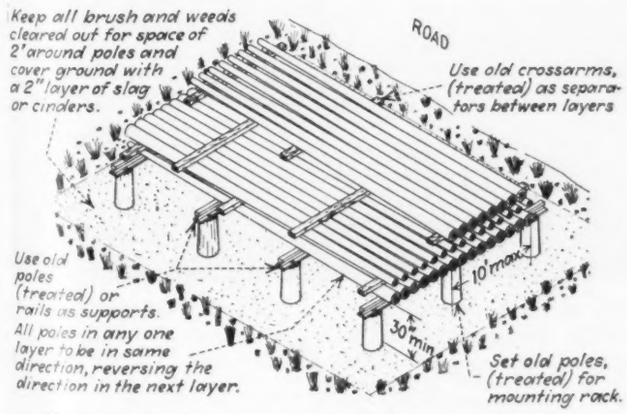
Attached to each breaker support, facing the outer aisles, are cabinets containing the breaker relays, circuit watt-hour meters and demand meters, test blocks for the instruments and Rectox units for supplying the direct-current closing circuits. The rectifying units are connected the instant the breaker disconnects are closed and dispense with other sources of direct current. Alternating current is used for breaker control. There are two CO relays on each breaker. Thirty-minute demands are registered on the meters. A 0-20-second duty cycle is used on the reclosing circuit breakers. During the short time that the substation has been in operation there have been no automatic reclosures, so it is impossible to say what per cent of the short circuits which may occur will be cleared on the first opening. Visual and bell alarms at the power house are connected with each breaker so it is possible to know when they operate, and if they remain open, in which case an inspector can visit the substation or investigate the circuit. The breakers are equipped for manual as well as automatic operation.

Series transformers for the feeder relays and meters are mounted just above the breakers and below the disconnects so that when the disconnects are open the control circuits are also open. Voltage transformers are connected to the 2,300-volt bus between the main transformers and feeder breakers with protective fuses.

From dusk to dawn the substation is floodlighted from a 2,300/110-volt transformer connected at the same place as the voltage transformers and with protective fuses. An automatic time switch (Sauter) turns the lights on and off. Thus light is always available in case an emergency call has to be made at night.

This 2,500-kva. step-down substation with six 400-amp. feeder breakers was built with C.W.A. labor for $46,338. An itemized list of the construction expenses is tabulated herewith. The substation was designed by Roberts & Company, Atlanta, Ga.

Efficient Pole Storage


Keep all brush and weeds cleared out for space of 2' around poles and cover ground with a 2" layer of slag or cinders.
ROAD
Use old crossarms, (treated) as separators between layers
Use old poles (treated) or rails as supports.
All poles in any one layer to be in same direction, reversing the direction in the next layer.
10' max.
30" min.
Set old poles, (treated) for mounting rack.

This typical pole storage yard on the West Penn System has proved very satisfactory after years of experience.

A Cure for a Seasonal Sales Drop

By E. H. BUECHELE
Public Service Electric & Gas Company, Newark, N. J.

During the first three months of 1933 the Public Service Electric & Gas Company of New Jersey secured 646 leads from employees, which resulted in the sale of $38,553 in gas and electric appliances. In the eleven months January to November non-selling employees turned in 927 leads, resulting in appliance sales of $270,327. The first three months of the year fell way below the balance of the year and this had been true of previous years.

To overcome this drop in the first quarter of 1934 the company organized a "teamwork campaign" in which non-selling employees and members of the sales department worked together as teams. A quota was set of $75,000 in electric and gas appliance sales for the months of January, February and March. Non-selling employees were offered a 2 per cent bonus, or a total of $1,500 on the quota.

The territory was divided into 27 districts, with several teams in each. The commercial agent of each division appointed team leaders and directed the activity. District selling units were composed of ten commercial employees and a team leader. When the work of organizing was completed group meetings were held, in which appliances were exhibited and instructions given. Non-selling employees were supplied with folders under promotion. Leads could be turned in only when the prospect had been personally interviewed.

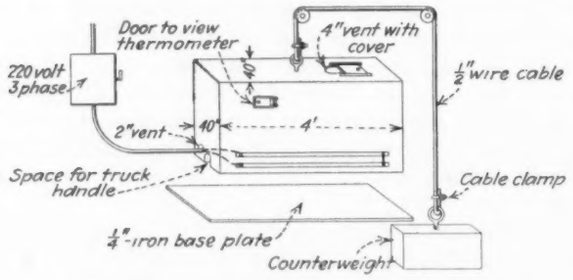
During the same period the commercial department staged a sales contest, in which each district sales organization consisted of a team and six teams formed a league. The league played five games, each consisting of twelve working days. Teams finishing in first place in each of the four leagues then conducted a sweepstakes match, the team earning the greatest percentage of its three months total dollar quota being the final winner. Teams finishing second, third, fourth, fifth and sixth in each league also competed in a sweepstakes. Money prizes were offered to the winning leagues and each team shared in its league purse. Additional individual cash prizes were offered in each game. Office sales and sales to employees were credited to the team, but not to the salesman. Much enthusiasm and friendly rivalry was built up by special meetings and bulletins which followed through the campaign.

As a result, the first quarter of 1934 showed total sales from leads from non-selling employees of $113,277, which was an increase of 193.7 per cent over the year before. A total of 8,897 leads were turned in by 1,591 employees. Of these 288 leads resulted in sales, the average sale being $24.44. Among the major appliances sold were: 401 refrigerators, 1,752 clothes washers, 377 ironers, 1,356 vacuum cleaners and 4,951 irons. Many of the 550 leads remaining unsold at the end of the campaign were live prospects, however, and have since been closed.

Motors Baked and Dried in Simple Electric Oven

By W. D. SHIPWAY
Electrician, Patten Blinn Lumber Company, Wilmington, Cal.

Means is not always at hand for drying out motors that have accidentally been water soaked or need revarnishing. At this plant a simple drying oven has been built out of $\frac{3}{16}$-in. sheet iron with four 600-watt, 110-volt space heaters. A lining of $\frac{1}{16}$-in. sheet is provided



Armature oven of sheet iron and asbestos

The seams of the outer $\frac{3}{16}$-in. shell may be welded or bolted with angle iron. Lining is $\frac{1}{2}$-in. asbestos with protecting inner shell. Leads are four No. 12 asbestos-covered wire taped together to serve four 600-watt strip heaters. Truck is of simple construction, $\frac{3}{4}$-in. boiler plate base, 6 x 1-in. disk wheels on 2-in. square axles. Fifth wheel arrangement in front makes turning easier.

to protect the $\frac{1}{2}$-in. lagging of asbestos against abrasion. The three parts of the walls are held together with $\frac{1}{4}$-in. stove bolts.

Heater units are connected two in series on two phases of a 220-volt, three-phase supply and mounted on studs on the side walls 3 in. off the bottom. The temperature is about 240 deg. F., which does a satisfactory job in baking. There is a 4-in. vent on top of the oven and one 2-in. vent in each end for air circulation and temperature control. These vents have sliding doors. An 8x4-in. door in the front is provided to view the thermometer. Baking a revarnished motor takes twelve to fourteen hours; drying a wet motor takes from 48 to 72 hours.

Rather than lift the heavy armature of a 150-hp. motor into the oven, the motor is mounted on a truck made of boiler plate which is used generally around the plant for transporting electrical equipment. The truck is wheeled onto the $\frac{1}{4}$-in. base plate of the oven and the oven is lowered over the truck and motor by raising and blocking the counterweight.

Oscillograph and Speed Counter Record Fractions of Second

By R. M. BAYLE
Industrial Division,
Westinghouse Electric & Manufacturing Company, Chicago

An oscillograph, the potential coil assembly of a discarded watt-hour meter and an ordinary speed counter have been successfully used to record fractions of a second during start-stop cycles as brief as $1\frac{1}{4}$ seconds in the test of a $\frac{1}{4}$-hp. motor driving a grease pump. The speed counter is mounted so that the wheel originally used to measure surface speeds rotates between the poles of the magnet. It is driven by the motor under test either by pressing the counter tip into the shaft center or by belting it to the motor shaft with a string. When excited, the magnetic circuit, with its large air gap, is decidedly unsaturated. With the wheel at rest, the oscillograph element deflects to a steady state proportional to the direct-current excitation. As the spindle of the counter rotates the inductor action superimposes an a.c. wave on the direct-current exciting current.

The film record of speed is a series of sharp-topped cycles, each representing a half revolution. Time is recorded by an a.c. wave of known frequency on another element. By laying off spaces equivalent to second intervals revolutions per second are counted. The tabulation of these increments gives an accurate speed curve showing acceleration, deceleration and all intervening speeds. If more accuracy is desired the time spacings are shortened. Fig. 2 is a typical oscillogram of test results.

Fig. 1—Little power is required to drive this simple inductor generator

By means of an oscillograph it records changes of speed. Two No. 14 24x¼-in. iron machine screws are mounted diammetrically opposite on the wheel to serve as poles.

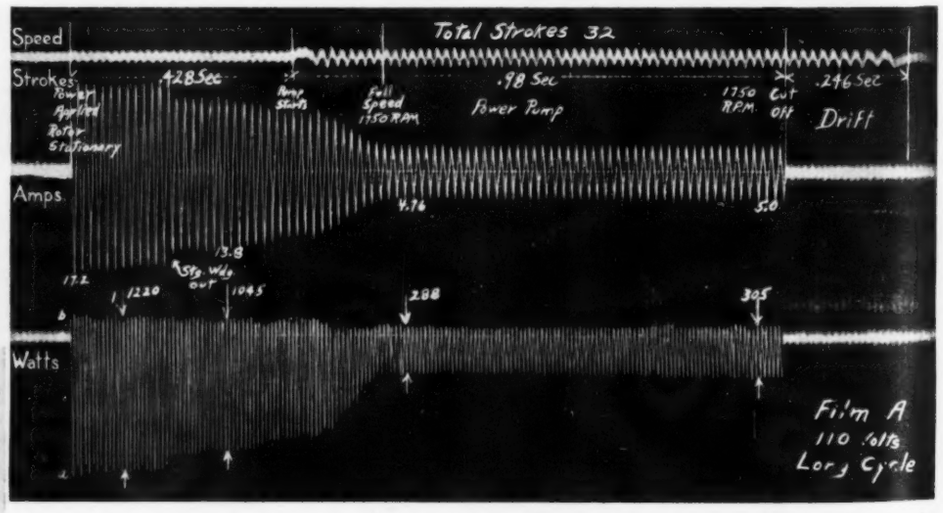


Fig. 2—Three-element record of the start-stop test of a $\frac{1}{4}$-hp., 1,750-r.p.m., clutch-type, single-phase motor connected to a grease pump

The top trace shows the speed, the middle amperes and the bottom watts. This cycle shows power was applied only 1.4 seconds. The speed record shows very clearly the lag between the application of power and the point where the clutch takes hold. Note the drift after the power is cut off and the rapidity of acceleration shown by the few speed cycles with broad abscissas. In this test the speed indicator is direct connected, and at full load speed will show approximately 58 cycles per second, yet every half revolution is readily discernible.

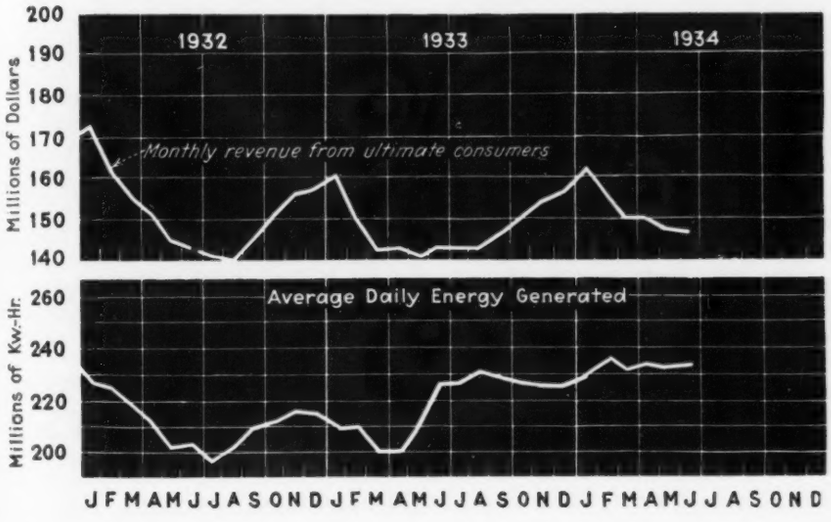
Utility Income Above 1933

Light and power revenue, $147,337,000, closely approached the May figure and surpassed last year's June by 2.8 per cent, while the six-month total rose 3.7 per cent. Domestic use broke the best previous record for June.

LIGHT and power companies virtually duplicated in June the revenue received from ultimate consumers in May, the amount being $147,337,000, according to the Edison Electric Institute. Revenue at this season usually falls off appreciably; the fact that the gain over 1933 in June, 2.8 per cent, was somewhat smaller than in the preceding month is explained by the unusual rise a year ago.

Total energy generated was 7,021,000,000 kw.-hr., an excess of 3.7 per cent compared with 1933, resulting in an average daily output about 1 per cent greater than in May. Production from water power fell to 36 per cent of the total and was 10.5 per cent less than in the same month last year. The diminution is ascribed to the effect of widespread drought conditions on stream flow. Correspondingly, production from fuels rose 7 per cent above May and was 14 per cent greater than in June, 1933.

Considering the first six months of the year as a unit, revenue from ultimate consumers aggregated $911,786,700. For the same period in 1933 it was $879,576,700, in 1932 $939,404,700 and in 1931 $1,001,886,100. Thus some recovery is shown in the increase of 3.7 per cent over last year, but revenue has not yet caught up with the records of earlier years. Statistics on operating expenses and taxes are not available, but such individual company figures as have been released show a very definite upward trend. If the totals were compiled they would probably show that the gains in gross income were fully balanced and perhaps exceeded by the rise in expenditures.



Domestic use gains 9.5 per cent

With respect to energy consumption the most noteworthy feature is the increase in domestic use of 9.5 per cent compared with June, 1933, and a moderate rise over May. The latter increase is exceptional, and the new June figure establishes a record for the month. Retail commercial sales gained 5.2 per cent over last year, but missed the record for the month, set in 1930, by 2 per cent. Culmination of the recent increase in wholesale commercial use is indicated by a mild recession from May and a gain of only 3.6 per cent over June of last year. Despite the strike the Pacific region led all others in relative gains.

Table I—Monthly Revenue from Ultimate Consumers and Energy Output of Central Stations in the United States

Compared with Corresponding Month of Previous Year

Month 1934	Revenue from Ultimate Consumers		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc
June	147,337	+2.8	7,021	+ 3.7	2,527	—10.5	4,494	+14.0
May	147,915	+4.8	7,193	+ 9.3	2,990	— 7.2	4,203	+25.2
April	149,852	+5.2	6,981	+15.2	3,282	+11.4	3,699	+18.8
March	149,780	+5.1	7,262	+15.9	2,932	+ 1.8	4,330	+27.9

Table II—Regional Revenue and Energy Output in June, 1934

Compared with Corresponding Month of Previous Year

Geographical Region	Revenue from Ult. Consumers		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.
United States	147,337	+2.8	7,021	+ 3.7	2,527	—10.5	4,494	+14.0
New England	12,554	+2.7	455	— 3.0	205	+ 9.5	250	—11.5
Middle Atlantic	43,120	+3.0	1,756	+ 5.0	471	— 9.0	1,285	+11.7
East No. Central	33,207	+3.1	1,689	+ 8.3	124	—30.6	1,565	+13.5
West No. Central	12,657	+5.0	455	— 1.3	79	—47.3	376	+20.5
South Atlantic	17,978	—1.9	816	— 0.3	432	—15.8	384	+25.4
East So. Central			277	—13.5	221	—20.5	56	+33.2
West So. Central	8,307	+3.7	387	+ 4.8	5	—82.5	382	+12.0
Mountain	4,225	+2.0	209	+ 3.3	166	+ 0.5	43	+15.0
Pacific	15,289	+5.4	977	+ 9.0	824	+ 3.4	153	+55.0

*By courtesy of U. S. Geological Survey, with deductions for operations not regarded as central station.

Table III—Allocation of Energy, June, 1934

Compared with Corresponding Month of Previous Year

Class of Service	Millions of Kw.-Hr	Per Cent Inc.
Total for distribution*	7,056	+ 3.6
Lost in transmission, etc	1,174	— 2.7
Sold to ultimate consumers	5,882	+ 5.0
Domestic	973	+ 9.5
Com'l. small light and power	1,049	+ 5.2
Com'l. large light and power	3,273	+ 3.6
Municipal street lighting	144	+ 0.7
Railways—street and interurban	338	+11.0
Railroads—electrified steam	55	+ 0.9
Municipal and miscellaneous	50	—11.3

*Generated, purchased from other sources and imported, less energy used in railway and other departments.

LETTERS TO THE EDITOR

Area Charge in Hartford Rates

To the Editor of the ELECTRICAL WORLD:

I am afraid that any one reading the notice relative to change in Hartford rates in the August 4 issue of ELECTRICAL WORLD would receive the erroneous impression that we had abandoned the principal of "space" as a factor in our rates. A *space factor*, either room or area, is of vital importance in domestic rates as the same is equivalent to giving weight to the lighting demand.

In our new rates the number of kilowatt-hours in the first high-priced blocks is dependent on the lighting demand above ⅓ kw. The demand, in turn, is either measured, counted or calculated at customer's option. When calculated, it is taken as ⅓ watt per square foot of house area, and as in 99 per cent of the cases this is the method which produces the lower demand it is obvious that the space factor still remains, although in a more palatable form than when set out as a fixed charge. To illustrate with a typical case:

Assume under old rate customer used 70 kw.-hr. and had an area charge of 96 cents corresponding to 1,200 sq.ft. The bills under old and new rates would be:

Old Rate

Area charge	$0.96
24 kw.-hr. at 4 cents	0.96
46 kw.-hr. at 3 cents	1.38
Total	$3.30

New Rate

12 kw.-hr. at 10 cents	$1.20
18 kw.-hr. at 5 cents	0.90
40 kw.-hr. at 3 cents	1.20
Total	$3.30

S. FERGUSON,
President.
Hartford Electric Light Company,
Hartford, Conn.

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More Discussion Urged on Appliance Cements

To the Editor of the ELECTRICAL WORLD:

You are to be complimented for publishing the article on the rare subject of appliance cements by Melton, Brownlee and Easter, in the ELECTRICAL WORLD for June 16. O. G. Vogel, in your August 4 number, takes issue on this educational article, which, in fact, is one of the few articles published on the subject, probably because the leading authorities of the largest electrical research laboratories have been unable to develop anything better than the insulation of the heater tubes of the Westinghouse-Nernst lamp of thirty years ago. The writer made that insulation more than thirty years ago. The tubes were made from fused quartz with a little bonding ceramic material and an organic binder. The resistance wire was platinum, then not so expensive, but suitable for higher temperatures than the resistance wires used today in appliances, consequently the elevated temperatures that were permissible with platinum would fuse the present resistance wires, hence greater insulation at elevated temperatures was necessary.

It is unfortunate that Mr. Vogel does not back up his issue with figures like the ones shown by Melton, Brownlee and Easter, because this important branch of the electrical business has not received the development in laboratories or government institutions that other branches of the business have published. There is very little literature on the subject and this makes the Melton, Brownlee and Easter ELECTRICAL WORLD article valuable.

I take issue with the electrical authorities who state that silicate of soda cannot be used as a binder for elevated temperature resistance cements, as we have made tests and our trade has thousands of appliances, resistors, etc., covered with silicate of soda cements (ceramic coverings) with wires as thin as hair which are still satisfactory after years of use; furthermore, the covering prolongs the life of the wire because it conducts the heat away from the wire and prevents oxidation.

C. FRED SAUEREISEN,
President.
Technical Products Company,
Pittsburgh, Pa.

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1931 Prices Were Below Cost

To the Editor of the ELECTRICAL WORLD:

I have read with great interest the article in the July 28 issue of ELECTRICAL WORLD entitled "What About Prices," and noted most particularly your statements with regard to wire and cable prices, as well as tape prices. You state at the end of the third paragraph: "Thus if 1931 prices were nominal and reasonable . . ." I gather from this, from the basis of your article, that you consider 1931 prices were nominal and reasonable. The records of the wire and cable and tape industries do not show this to be a fact, as prices in 1931 were decidedly subnormal and, in fact, were actually below cost, as shown by the losses of all manufacturers.

Taking rough figures, the wire and cable 1930 volume was about half 1929 volume and the 1931 volume was about half the 1930 volume. This tremendous and almost vertical drop in volume brought about, in 1931, the demoralized condition of the wire and cable industry that you mention as generally existing in 1932 and the first part of 1933.

Therefore, in studying wire and cable price advances from 1931 to date, you must, in addition to considering the raw material prices at the various dates, also consider the fact that 1931 wire and cable prices were on the basis of sales below cost, ranging anywhere from 5 to 25 per cent below cost. Taking these facts into consideration, wire and cable prices today have not advanced abnormally, and are far from being on any high profit level.

The condition of tape prices in 1931 was very similar to the condition of the wire and cable prices. Increases since 1931 in tapes have been aggravated, on the part of friction tapes, by the cotton textile situation, processing and floor taxes, etc., and on the part of rubber tapes by the enormous increase in the price of crude rubber, running into several hundred per cent.

Starting in 1931 with tape selling below cost, in considering prices today based on the enormous increased costs of raw materials, for tapes, the prices may seem abnormally high. I do not, of course, know what date you took in figuring your tape prices, but I do know that within the last 30 to 60 days tape prices have fallen considerably, until it looks as though they were again heading for either a profitless level or a level actually below cost.

F. C. JONES,
President.
The Okonite Company,
New York, N. Y.

BOOK REVIEWS

Die Drehzahlregelung von Asynchronmotoren

(Speed Control of Asynchronous Motors)

By Hans Zabransky. Published by Carl Heymanns, Verlag, Berlin W 8. 208 pages. Price, paper, 14.00 reichsmarks; bound, 16.00 reichsmarks.

The full title limits the subject to the method of control by concatenated a.c. commutator machines. The fundamental German patent for controlling the speed of an asynchronous motor by concatenation with an a.c. commutator motor was granted in 1905. The object of this book is to trace subsequent development in this field, up to the end of July, 1933. The treatment is in the form of a running commentary on the successive patents supplemented by references to important articles in technical periodicals. Division is made into sections according to the various objectives to be obtained, so that the story in each section runs consecutively. The book should be of value to engineers seeking a detailed account of the progress that has been made in this mode of speed control, to inventors who need to know precisely what ground has been covered by previous workers, and to patent attorneys.

NEWS OF THE WEEK

Bond Deposit Limit Extended by T.V.A.

Deadline on Knoxville plan extended to September 15—Alabama Power directors refuse to proceed against T.V.A.

Announcement has been made that the time in which deposit of the 5 per cent bonds of Tennessee Public Service Company, under the Tennessee Valley Authority purchase plan, must be made has been extended to September 15. Originally the deadline was set for August 21. It was stated that due to the vacation time and the need of institutions to take corporate action before depositing holdings it was deemed advisable to extend the final date of deposit.

David E. Lilienthal, T.V.A. official, said last week before sailing for England that there would be no extension. A check on the situation showed that many holders had signified intention of depositing their bonds, but could not until corporate action had been taken by directors and, in some cases, legal sanction had to be obtained. It was also found that some holders would deposit their bonds when they returned home from vacation trips.

When the T.V.A. agreed to purchase the Knoxville, Tenn., electric properties of Tennessee Public Service Company it was stated that one condition was that holders of the $7,000,000 of 5 per cent bonds outstanding would accept 96½, the offering price, for their bonds. Mr. Lilienthal stated recently that unless the bonds are deposited and the plan as now proposed becomes effective Knoxville will let contracts for the construction of a competing electric distribution system obtaining power from Muscle Shoals.

Alabama directors uphold contract

The board of directors of the Alabama Power Company adopted a resolution refusing the request of a group of preferred-stock holders who recently petitioned the company to institute legal proceedings to test the validity of the Tennessee Valley Authority act and to set aside the contract involving the sale of certain properties by the company to the T.V.A. (ELECTRICAL WORLD, August 18, page 219). Detailed reasons were given by the board as to why the company entered into the agreement with T.V.A. "Under the circumstances," the statement said, "the company has considered that the most satisfactory alternative was to yield to the insistence of the T.V.A., obtain the best price obtainable for the transmission and distribution systems demanded by the authority as a minimum and protect the company with the best obtainable agreement for limitation of competition by the authority through federal funds."

Withdrawal of suits sought

Resolutions requesting the Alabama Public Service Commission not to ask the authority to file its rate schedules with the state body and calling upon certain ice and coal companies in the state "to support the President, to withdraw their litigation and join in the policy of development of the South" were adopted at a meeting of representatives of fourteen north Alabama municipalities last week.

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New Middle West Plan; Separate Trial Denied

Plans for raising new money through the sale of preferred stock with a common stock bonus to buy out secured creditors of Middle West Utilities Company have been abandoned and the noteholders' committee is considering a plan whereby new common stock would be offered to noteholders at the option price of $6 a share and to preferred- and common-stock holders at an increase above the option price, according to R. N. Golding, the attorney for the Noteholders' Committee.

Enough new common stock would be offered to raise $12,000,000 with which to buy out the secured creditors and add something to working capital, he said. In any event, the note holders will receive a certain amount of new common stock for their present holdings of serial notes, he added, and the total number of new common shares to be initially outstanding is to remain at 3,000,000.

After re-examining the indictment and arguments, Federal Judge James H. Wilkerson has denied Samuel Insull's appeal for a separate trial on mail fraud charges connected with the collapse of his utility enterprises. Judge Wilkerson took into consideration the two phases of the defense plea for a severance, the state of the defendant's health and the fact that the case may require several months for trial and tax his endurance. The judge found it difficult to see how a severance would be of benefit with no way to determine probable duration. He pointed out also that no motion for severance had been made by any of the other defendants on grounds of prejudice in a joint case.

Profits Are Denied to Municipal Plants

New York Public Service Commission rules such plants were not created for gain—All municipally-owned projects affected.

Maintaining that the fundamental reason for the existence of municipal utility plants was to obtain adequate service at lower rates than private corporations can provide, the New York Public Service Commission, in an opinion made public last week, ruled that municipal plants should not make a profit on their operations. The commission's decision, which was the result of complaints by consumers of the electric plant in Boonville, Oneida County, was said to be the first ruling in the state on the subject. Unless it is overruled by the courts, it will affect all municipal utilities.

At the proceedings in the case arguments upholding a community's legal right to a fair return on its property were presented by Dean Paul Shipman Andrews of Syracuse University, representing the Municipal Electric Utilities Association, which has a membership of twenty plants, and also by representatives of several villages individually.

Reasonable rate defined

The commission held that a just and reasonable rate for municipal plants was one that produced sufficient revenue to cover the cost of service, and this general principle was held to apply also to service rendered by such a plant outside the municipality. "The purpose for which municipal corporations are created and governmental powers conferred upon them is in direct opposition to the theory that profits should be made out of their operation," the opinion read. "Governments exist for public well-being; they are not created for the purpose of making profits. Obviously, the purpose in seeking to obtain such a profit, as certain municipalities contend for in these proceedings, over and above all costs and suitable reserves, is to transfer such profits to the village general fund to be used to reduce its taxes or to promote other municipal projects."

The opinion objects to such a policy as "indirect and unfair taxation of consumers." It pointed out that consumers were not necessarily taxpayers and that where they were, they did not pay electric bills in the same proportion that they paid tax bills. The commission's opinion made it clear that all reasonable costs of rendering service should be included in the rates charged.

Drought Cuts Output From Water Power

Energy generated during June by public utility plants in the United States is reported by the U. S. Geological Survey as 7,453,000,000 kw.-hr. This constitutes an increase over the same month in 1933 of 3 per cent, compared with 10 per cent in May. The average daily production was 248,000,000 kw.-hr., a small increase from the average daily production in May, the total for that month having been 7,681,000,000 kw.-hr., against 7,443,000,000 kw.-hr. in April.

Figures for the first six months show that the seasonal decrease has been smaller than usual; the average daily production for successive months has been almost constant.

The decrease in output from water power which began in May with a marked drop in average daily output continued in June, owing to the effect of the drought on stream flow in different parts of the country. This average dropped from 116,200,000 kw.-hr. in April to 103,800,000 kw.-hr. in May and 90,300,000 kw.-hr. in June. Expressed in per cent of total production, it decreased from 47 in April to 42 and then to 36. The decrease is being offset by an increase from fuel-burning plants, which produced 3,955,000,000 kw.-hr. in April, 4,463,000,000 kw.-hr. in May, 4,745,000,000 kw.-hr. in June; regional gains over 1933 in June (with May figures in parentheses) show the following percentages: New England, —5 (+9), Middle Atlantic, +5 (+10); East North Central, +9 (+16); West North Central, —3 (+2); South Atlantic, —3 (—6); East South Central, —10 (+18); West South Central, +6 (+3); Mountain, —5 (+21); Pacific, +6 (+14).

The survey report covers all classes of utility plants, including not only those for electric light and power, but also plants for traction, Bureau of Reclamation and others generating energy for public use.

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Thayer Probe Costs $63,000

Investigation of New York State Senator Warren T. Thayer on implied charges of improper relations with public utility interests and his retirement from the Senate will cost the taxpayers of the state $63,000. Of $25,000 appropriated originally for the inquiry by the Senate Judiciary Committee, $18,000 has been spent. The legislative leaders have agreed on an additional appropriation of $38,000 to cover a fee of $30,000 for Paul J. McCauley of New York City, counsel for the judiciary committee and his four assistants; a fee of $10,000 for former Senator Clayton R. Lusk, counsel for Senator Thayer; $4,500 for printing and other expenses for witnesses.

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Railroad Electrification Stimulates Employment

Electrification of the Pennsylvania Railroad's main line between New York City and Washington, D. C., is almost 50 per cent completed, according to an announcement by the company. Funds obtained through the Public Works Administration have permitted the company to put 12,000 men to work on a weekly payroll of approximately $300,000. Of the government fund, $23,500,000 has already been expended in domestic markets, and the announcement stated that at least 25,000 men had been afforded employment through this disbursement. Passenger service over the electrified line is to start by January.

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Italian Society to Meet

The thirty-ninth annual conference of the Associazione Elettrotechnica Italiana is to be held in Gardone, Italy, from September 23-30. Among the numerous papers to be read are one by N. Ratti on "Disturbances in Hydro-Electric Machinery," and one by S. Spagnoletti on "Vibration in Electrical Machines and Their Foundations."

COMING MEETINGS

International Association of Municipal Electricians — Wardman Park Hotel, Washington, D. C., August 29-Sept. 1. W. H. Harth, City Hall, Columbia, S. C.

Producers and Distributors of Electrical Energy—Fifth International Congress, Zurich and Lausanne, Switzerland, August 29-Sept. 7. Secretary, Union des Centrales Suisses d'Electricite, 301 Seefeldstrasse, Zurich.

American Institute of Electrical Engineers—Pacific Coast Convention, Salt Lake City, Utah, September 3-7. General Convention Committee, 1016 Continental Bank Bldg. Salt Lake City, Utah.

Rocky Mountain Electrical Association—Annual convention, Estes Park, Colo., September 10-12. G. E. Lewis, Managing Director, Gas & Electric Bldg., Denver, Colo.

Association of Iron and Steel Electrical Engineers—30th convention, held in conjunction with the Iron and Steel Exposition, Cleveland, Ohio, September 18-20. J. F. Kelly, Empire Bldg., Pittsburgh, Pa.

National Electrical Exposition — Madison Square Garden, New York, N. Y., September 19-29. Ralph Neumuller, Electrical Association of New York, Grand Central Palace, New York.

Electrochemical Society — Sixty-sixth convention, Hotel Pennsylvania, New York City, September 27-29. Colin G. Fink, Columbia University, New York.

Illuminating Engineering Society — Annual convention, Baltimore, Md., October 1-4. D. W. Atwater, Secretary, 29 West 39th Street, New York.

National Electrical Manufacturers Association—Annual meeting, Chicago, October 17-20. W. J. Donald, 155 East 44th St., New York.

. . . THIS WEEK IN WASHINGTON

Federal Power Commission defers action on Flathead project—Lockport (N. Y.) seeks license for Niagara power.

AT THE request of the Secretary of Interior, the Federal Power Commission has given assurances that it will take no action for a period of six months in connection with the Flathead project of the Rocky Mountain Power Company. The license of the power company for the project was about to expire. The commission was unwilling to grant the application of the company for an indefinite extension of the license. Officials of the Interior Department, however, are anxious that there be no revocation of the license since it involves payments to Indians of $60,000 annually when the plant will have been completed. These payments are graduated over a period of sixteen years, when they increase to $175,000 annually. Construction work on the plant has been suspended for more than a year due to changed conditions growing out of the depression.

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Montana Power Company has applied for a license covering its constructed plant on Madison River in lieu of the permit of the Department of Agriculture, under which it has been operating.

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The city of Lockport finally filed its application for license with the Federal Power Commission covering the 275 sec.ft. of Niagara River water acquired by the Niagara Falls Power Company from former users on 18-Mile Creek. "The question now is an open one," said Chairman McNinch, "as to whom shall be granted a license to use the last unlicensed remainder of Niagara Falls water power."

PAUL WOOTON,
Washington Correspondent.

Danville Project Opposed

Disapproval has been expressed by the Federal Power Commission of the development by the city of Danville, Va., of the Smith Mountain hydro-electric site under contemplation by a committee designed to point the way to the safest means of providing the city with more power under municipal auspices. In a letter received by J. Allan Herman, chairman of the committee, the commission stated that a 60-ft. dam would not develop the property to its maximum capacity and for the city to raise a dam of 125 ft. would not only make the undertaking too costly but would provide more power than Danville can use.

Power Commission Rules on Portland Utility's Project

In the controversy between the Portland General Electric Company and the Federal Power Commission as to the actual legitimate cost of construction of the company's original Oak Grove power project, on the Clackamas River and Oak Grove Creek, Oregon, the commission has recently fixed the sum at $9,131,710 as of Jan. 31, 1931. The finding reduces the claimed cost $35,334 and disallows $206,437 of the $887,928 claimed for interest during construction, a total reduction of $241,772. The claimed cost of $1,101,964 in the second unit is reduced to $824,078, $212,916 of the total reduction of $277,885 being disallowance of interest as computed by the licensee.

Two important points were decided by the commission in this case. One disallowed the interest rate claimed by the licensee and fixed 6 per cent as the fair rate of interest during construction. The commission also determined the period in which a part of initial investment in a power project can be carried in suspense.

In an opinion drafted by Commissioner Claude L. Draper, the commission holds that "the theory that a proportion of the initial investment in a project should be carried in suspense after completion of the first unit until other project units are constructed, permitting interest to run on such 'unused capacity,' is not in conformity with the federal power act and is unsound in principle." The other opinion determines the annual charges assessed against the project, for administration and occupancy of government lands, and the adjustment of the project's power capacity, which is fixed at 41,400 hp.

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Highway Vapor Lamps

Twelve units of G.E. sodium-vapor lamps, each rated at 10,000 lumens, were recently placed in service on Jerome Avenue, between 233d Street and Yonkers, in the metropolitan area of New York. The installation is the first highway application of such lamps in the vicinity of the metropolis.

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G. E. Bellows Compound

For new relays, or in place of leather bellows in existing relays, a new compound used by General Electric for its plunger type relays has been found to produce a greater degree of reliability and longer life for the bellows. They require no oiling or dressing to keep them in operating condition. In accelerated aging test, in an oxygen bomb for a period equivalent to a period of 42 years of normal aging, the depreciation of the bellows was less than 25 per cent, while a depreciation to 50 per cent would still be satisfactory for relay operation.

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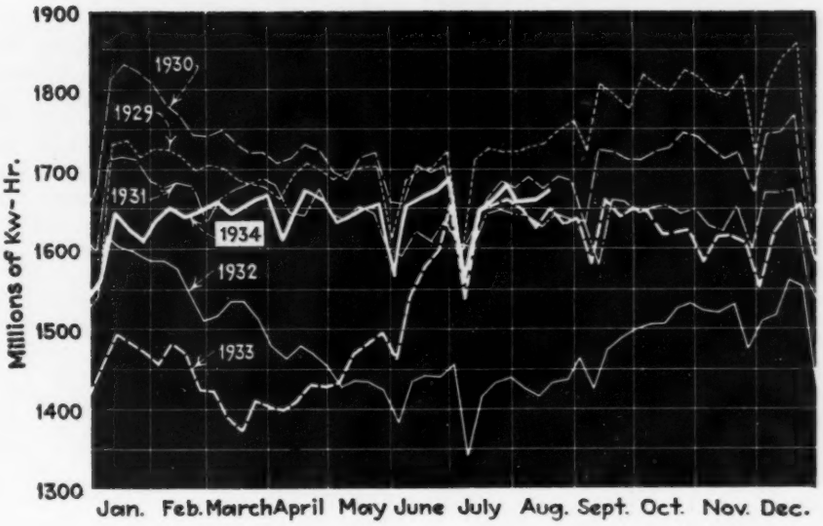
British Station Extended

Important extensions of Chesterfield Corporation's generating plant at the Brampton power station, England, have just been started at a cost of £64,000 ($320,000). The scheme will increase the capacity of the plant from 6,800 kw. to 16,800 kw. It is proposed to extend the turbine house with a steel and corrugated iron structure and to install two 5,000-kw. turbo-alternators at a cost of £30,900 ($154,500) and two water-tube boilers at a cost of £17,700. A water-cooling tower with a capacity of 350,000 gal. per hour is to be constructed.

Energy Again Matches 1930



Output of electric light and power plants during the week ended August 18 virtually caught up again with production in 1930, after hovering somewhat below that year's figures for a month. The amount as announced by the Edison Electric Institute was 1,674,345,000 kw.-hr. This indicates a rise of 1 per cent over the preceding week and an excess of 1.5 per cent compared with the same period last year. It has been equaled or surpassed only three times in 1934.

In New England the output fell short of last year's by 7.0 per cent and in the Rocky Mountain region by 8.2 per cent. Both are recessions from the preceding week.

All other regions report gains, the largest being 12.3 per cent in the West Central. The gain in the Central industrial area, though only 1.1 per cent, is the best showing in seven weeks. In the Middle Atlantic states the margin rose to 3.8 per cent.

Weekly Output, Millions of Kw.-Hr.

1934	1933	1932
Aug. 18...1,674	Aug. 19...1,650	Aug. 20...1,432
Aug. 11...1,659	Aug. 12...1,627	Aug. 13...1,415
Aug. 4...1,658	Aug. 5...1,650	Aug. 6...1,427
July 28...1,684	July 29...1,662	July 30...1,440
July 21...1,664	July 22...1,654	July 23...1,434

Per Cent Change from Previous Year

Region	Week ended Aug. 18	Aug. 11	Aug. 4
New England	— 7.0	— 5.9	— 8.6
Middle Atlantic	+ 3.8	+ 1.7	+ 1.0
Central Industrial	+ 1.1	— 0.3	— 2.6
West Central	+12.3	+11.5	+ 9.7
Southern States	+ 1.9	+ 1.3	+ 1.7
Rocky Mountain	— 8.2	— 3.7	— 1.5
Pacific Coast	+ 5.4	+ 8.1	+ 8.2
United States	+ 1.5	+ 1.9	+ 0.5

British Output Increases

Official statistics which have just been submitted to the British Electricity Commission show that 1,042,000,000 units of electricity were generated by authorized undertakers in the United Kingdom during July, 1934, compared with the revised figure of 913,000,000 units in July, 1933. This represents an increase of 129,000,000 units, or 14.1 per cent. The number of working days was 26 in both months.

During the first seven months of the year the total amount of electricity generated by authorized undertakers throughout the country was 8,672,000,000 units, compared with the revised figure of 7,408,000,000 units for the corresponding period of the year 1933, which represents an increase of 1,264,000,000 units, or more than 17 per cent.

As to Rates . . .

• Georgia Power & Light Company's petition for a temporary order restraining the state Public Service Commission from reducing electric rates was refused by the Fulton Superior Court. The three-judge court took the position that the light and power company failed to show that irreparable injury will result unless a temporary injunction is granted and held that an auditor should be appointed to report on the law and facts in the case, the issues eventually to be submitted to a jury for final decision. The company contended that the proposed rates are confiscatory and charged a conspiracy between members of the Public Service Commission and Governor Talmadge to lower rates. John T. Goree, Assistant Attorney-General, stated that the 15 per cent reduction, which will appear on the August bills, places all electric companies in Georgia on lowered rates, with the exception of a few municipalities in which retail energy is purchased wholesale and sold by the cities to the people. The Georgia Power & Light Company's cut applies to domestic and commercial rates only, there having been no contention on the question of industrial rates.

• Tennessee Light & Power Company has been ordered by the state Railroad and Public Utilities Commission to reduce its rates approximately 20 per cent. The towns in which the reductions apply are Mitchellville, Orlinda, Portland, Cedar Hill, Cross Plains, Pleasant View, Cooperstown, Camden, Hollow Rock and Big Sandy.

• United Electric Light Company, Springfield, Mass., has voluntarily reduced its electric light rates $85,000 annually under schedules filed with the state Department of Public Utilities, to become effective October 1. The new rates will mean a saving of $50,000 to the company's 40,000 domestic customers and additional savings of $10,000 to commercial users and $25,000 to industrial accounts.

• Maryland Public Service Commission has set September 17 as the date to open a further hearing dealing with rates, charges, services, properties and affairs of the Potomac Edison Company. The case has been pending since the commission filed its opinion and order in November, 1932, following a lengthy hearing. After the order was handed down the company protested the valuation placed on the properties by the commission. Hearing on the protest was held and in March, 1933, the commission handed down another order confirming its original findings. Following this action the company took the case into the courts and it is still pending there. The hearing to open September 17 will be for the purpose of bringing the case up to date and to determine rates.

• Public Service Company of Colorado has been accused in a complaint filed with the state Public Service Commission of excessive rate charges. "The Public Service Company," the complaint states, "under its schedules filed with the commission and under its franchise derived from the city, charges and exacts from consumers of gas and electricity in Denver rates which are unreasonable, unjust and discriminatory and which allow the company earnings and revenue in excess of a fair and just return on the value of its property, owned and used for the purpose of furnishing that service." The plaintiff alleges the commission has not ascertained or fixed any reasonable standards, rates, classifications, regulations, practices, measurements or service to be furnished and followed by the company. The complaint is the first move in a legal battle designed to determine the jurisdiction of the commission to regulate rates in Denver. The Colorado Supreme Court ruled in 1919 in a telephone case that the commission was without jurisdiction to regulate the rates in home-rule Denver. Attorneys who filed the petition believe it will be dismissed by the commission on the basis of the 1919 ruling.

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Litigation Delays Project

Pending the outcome of litigation involving the project, construction of a municipal light and power plant and distribution system at Sullivan, Mo., has been indefinitely postponed. The city's application for a P.W.A. grant and loan of $85,000 is still held up in Washington.

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Iowa Plant Postponed

Action on the proposed municipal light and power plant at Oskaloosa, Iowa, has been deferred to a future time. It is possible that the project may be revived in 1935. Cost of the system has been estimated at $462,000. It had been planned to finance the cost in part with P.W.A. funds. Last February an election on the question of issuing $322,883 in bonds for the plant resulted in a tie vote.

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Peru, Ind., Cuts Rates

Reductions in rates of the municipal electric plant at Peru, Ind., the second in a year, have been authorized by the City Council to take effect September 1. The city is extending its rural service over a wide radius and the new ordinance provides that rural patrons will be given the same rate as city patrons. The new schedule is 5 cents per kilowatt-hour for the first 50 kw.-hr., 3 cents for the second 50, 2 cents for the third 50, and 1½ cents for all over 150 kw.-hr. in any month. The low rate was ordered to promote the use of more electrical household equipment. In spite of a previous rate reduction, the company has earned $60,000 in the last year.

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Seek to Increase Utility Assessments

Under an order made by County Judge Jarecki on the motion of Hayden N. Bell, assistant state attorney in charge of tax matters, the Illinois Tax Commission would increase the 1931 assessments of the Commonwealth Edison Company and the Peoples Gas Light & Coke Company. The increase for the Edison company would be $10,721,140 and for the Peoples Gas Company $3,913,604.

According to Attorney Bell an error in computation by a previous commission cost the county $1,075,734 in revenue and collection of that amount from the two utilities is sought. It was stated that the commission made capital stock assessments of the worth of the two companies, real and personal, from which were to be deducted tangible personal assessments made by local assessors. In both cases, according to the memorandum filed by Attorney Bell, erroneous figures, representing the tangible part of the assessments, were deducted.

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Electric Progress in Japan Reported by Commission

The commission appointed some time ago by the Japanese government to inquire into the question of the unification and co-ordination of electricity distribution throughout Japan with the object of increasing the demand has recently presented its report. It states that the output of electric power in the country during 1933 amounted to, roundly, 17,403,000,000 kw.-hr., of which 14,700,000,000 kw.-hr. was furnished by hydroelectric plants and 2,703,000,000 kw.-hr. by steam and internal combustion-engined stations.

In connection with the growing use of electric power for industrial purposes, the report mentions that during last year more than 5,000,000,000 kw.-hr. was utilized in this way. The commission has put forward proposals for a five years' plan for the construction of new hydroelectric power stations and the extension of the distribution system which will be under the supervision of the Japanese government and possibly with its financial support.

FINANCIAL · · · BUSINESS

Electric Wholesale Code Approved by NRA

Code for the electrical wholesale trade has been approved by the National Recovery Administration and the General Code Authority and the local code commission will be appointed in the near future. Under the terms of the code lump sum bidding is not permitted. Quotations must show the price of each and every item. Neither split shipments nor free deliveries are allowed. Another provision forbids the return of goods after 60 days.

Provision is made for limiting cash discounts. None are to be given for payment after the tenth of the month following shipment and no greater discount is permitted than that allowed by the manufacturer of the product. By a vote of the majority in number and volume, uniform operating hours for electrical wholesalers may be established in any trade area.

The code authority will prepare a budget to cover cost of administration of the code and basis for an assessment to meet this expense. Non-payment of assessment by a member of the trade will be a violation of the code.

Tool and welding codes

Approval to the supplemental code of the electric tool subdivision for submission to NRA has been given by the board of governors of the National Electrical Manufacturers Association. The supplemental code for the electric welding subdivision, which has been revised to meet changes suggested by NRA in preliminary negotiation, has also been approved.

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Bonneville Turbine Bids Submitted by Manufacturers

Bids have been submitted by three manufacturers to the U. S. Army Engineers in Portland for the initial two 60,000-hp. Kaplan-type hydraulic turbines to be installed at the Bonneville project on the Columbia River. The figures submitted covered turbines and governing equipment and were as follows: S. Morgan Smith Company, York, Pa., turbines, $1,119,331; governing equipment, $73,744. Pelton Water Wheel Company, San Francisco, turbines, $1,180,280; governing equipment, $74,800. Allis-Chalmers Manufacturing Company, Milwaukee, turbines, $1,181,285; governing equipment, $70,840. All bids were on an f.o.b. factory basis. Ultimately there will be ten turbines.

WAITING

Business men await hopefully a revival of business in the fall, but are doing little to commit themselves on the plea that uncertainty still prevails. The government apparently is making extraordinary efforts to stimulate the fall business program. It is clarifying and remodeling the NRA, pegging cotton prices to make cotton loans, aggressively pushing housing loans, urging direct loans to industry and expediting construction projects—all to get recovery as well as a favorable background for fall elections.

Active business operations maintain normal seasonal levels, with a drop from the previous week in steel activity, carloadings, bank debits and automobile production. Yet electric power output continues upward and gives a significant indicator of preliminary factory production, as well as evidence of appliance sales. Increases in food costs affect retail trade and forces consumer buying toward low-priced goods and foods. Major labor conflicts still remain in the offing, with the steel industry as the critical battleground. On the other hand, the threat of the textile strike is over—production was at too low a level to hazard a strike.

LIGHT FOR LONGCHAMPS

Wide World

Parisian devotees of the "king of sports" now enjoy midnight races at the Longchamps track outside Paris. Here is the course illuminated for the first time on the occasion of the running of the "Grande Semaine."

General Electric to Build Huge Generator for Ford

Henry Ford signed an order this week which provides for $5,500,000 in capital improvements during the next ten months and for doubling the power capacity of the Ford Motor Company's Dearborn plant. The $5,500,000 will purchase one 110,000-kw. generator, one high-pressure boiler and the necessary auxiliary equipment, in addition to one 15,000-kw. turbo-generator unit. The generator will be made at Schenectady by the General Electric Company. With the units installed during 1929-30, this will bring the capacity of the River Rouge plant up to 2,200,000 lb. an hour of high-pressure steam for power generation.

The new 110,000-kw. generator, which will incorporate several new engineering features, will be the first large unit anywhere in the world to operate at 1,200 lb. pressure and 900 deg. F. The 15,000-kw. non-condensing turbine, to be installed in the same station, will furnish process steam to the Ford factory at 250 lb. pressure.

The 110,000-kw. machine is a vertical

compound unit. The high-pressure turbine and generator will be mounted directly on top of the low-pressure turbine and generator. Each element has a capacity of 55,000 kw. and generates at 1,800 r.p.m.

The new machine will be delivered in less than a year. Its complete technical rating is 110,000 kw., 80 per cent power factor, 13,800 volts, 1,800 r.p.m., three phase, 60 cycles, with steam conditions of 1,200 lb. gage pressure, 900 deg. F. total temperature and 1-in. absolute back pressure.

Steam will enter the upper turbine unit at 1,200 lb. pressure and 900 deg. F. total temperature and, after producing 55,000 kw., will flow down and into the low-pressure unit, where it will produce another 55,000 kw. Air coolers will be built integral with the generators and will be connected so that the heat losses in the generators will be recovered and returned in the feedwater.

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Power Exposition Planned

Unusual mechanical exhibits are being planned for the eleventh National Exposition of Power and Mechanical Engineering to be held at the Grand Central Palace, New York, December 3-8. The last exposition was held in 1932. Obsolescence in the fields which the Power Exposition serves is an important incentive. Meeting the revitalization of industrial purchasing, the aim of exhibitors will be to show exactly the status of their production development and latest products. The week of the exposition coincides with that of the national midwinter meeting of the American Society of Mechanical Engineers. The exposition is under the direction of the International Exposition Company, with Charles F. Roth again personally in charge.

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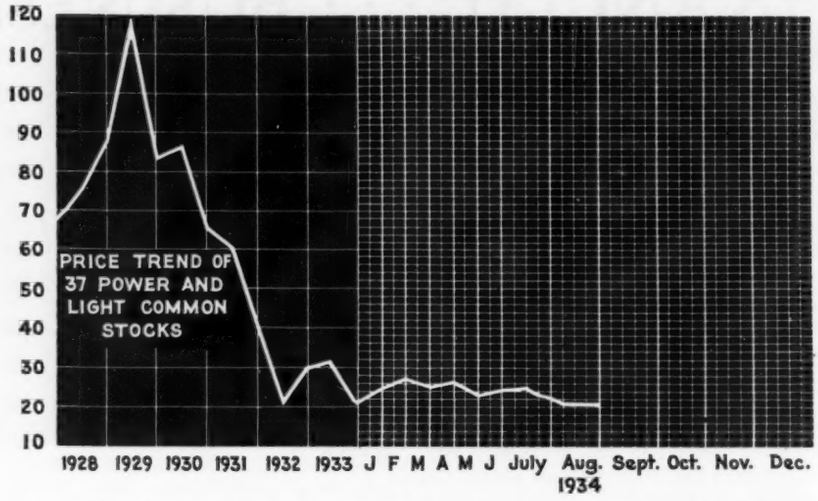
Public Utility Awards $76,982,800 in 1934

Construction awards through July continued above the corresponding monthly totals of last year, according to the F. W. Dodge Corporation. The July volume of $119,698,800 for the 37 Eastern states contrasts with $82,554,400 for July, 1933, and $127,116,200 for June of this year. For the first seven months of 1934 construction awards amounted to $973,861,500 for the 37 Eastern states, as against 514,667,800 for the corresponding seven months of 1933. The cumulative gain over 1933, amounting to approximately 90 per cent, was almost entirely due to the rise in publicly financed construction projects growing out of the P.W.A. programs. This class of work alone totaled $624,273,200, as compared with $181,549,500 for the corresponding seven months of last year.

Few Changes in Utility List



In a market that moved generally upward, electric light and power stocks showed no perceptible trends. *Electrical World* index remained unchanged for the third consecutive week at 20.9.

Public utilities awards in July were smaller than in June, but were almost twice as large as in July, 1933. For the year to date contracts for this class of construction, amounting to $76,982,800, were more than twice as great as in the similar seven-month period of 1933.

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Anaconda Wire Profits $611,614 in 1934

For the quarter ended June 30 net profit of the Anaconda Wire & Cable Company totaled $465,174, after depreciation, obsolescence and other charges, but before federal taxes, against $146,440 in the preceding quarter and a net loss of $65,009 in the June quarter of the previous year. For the six months ended June 30 net profit, before federal taxes, amounted to $611,614, contrasted with a net loss of $449,589 in first half of 1933.

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Refrigerator Shipments Up

July shipments by Kelvinator Corporation totaled 19,752 units, a considerable increase over those for the previous month and 28 per cent ahead of shipments made in July, 1933. In announcing the figures, H. W. Burritt, vice-president in charge of sales, said that July shipments brought the total for the first ten months of the present fiscal year up to a point 31 per cent ahead of shipments for the entire preceding fiscal year.

Officers of Leonard Refrigerator Company have announced that July shipments brought the total for the fiscal year to date up to 34 per cent ahead of those for the entire previous year.

Superheater Net Increases

For the six months ended June 30 Superheater Company, including its Canadian affiliate, reports net income after depreciation, federal taxes, minority interest and other charges, amounting to $303,103, equal to 34 cents a share on 874,554 no-par capital shares, against $104,851, or 12 cents a share, on 874,874 shares in the same period last year.

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Westinghouse Railway Order

In order to provide for the natural growth of its system and to take care of future increase in its requirements for electrical power, the Cleveland Railways Company has recently entered an order with the Westinghouse Electric & Manufacturing Company for rectifier equipment to consist of two 750-kw. mercury-arc rectifiers and auxiliary apparatus, switching and transformer equipment for its new Rocky River substation. The substation will be in operation to provide for traffic at the National Air Races. Power for this new substation will be obtained from the lines of the Cleveland Electric Illuminating Company at 4,600 volts, or 11,000 volts, three phase, 60 cycles, which will be converted by the transformer and rectifier equipment to direct current at 625 to 672 volts.

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Blaw-Knox Nets $105,214

For the six months ended June 30 Blaw-Knox Company and subsidiaries report net profit after interest, depreciation, taxes and other charges of

$105,214, equal to 8 cents a share on 1,322,395 no-par capital shares, compared with net loss of $102,075 in first half of 1933.

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Air Conditioning Provided for South African Mines

First step in a program to air condition the mines of the famous South African gold fields is the award of a contract to Carrier-Brunswick International, Inc., of Newark, N. J., for the air conditioning of Robinson Deep Mine, near Johannesburg, one of the deepest mines in the world. The installation, which will involve an expenditure of approximately $500,000, has been designed to supply 400,000 cu.ft. of air per minute to the mine workings, which penetrate 8,000 ft., or nearly 1½ miles, below the earth's surface.

The air-conditioning plant will be located on the surface near the mine shaft, consisting of three giant Carrier centrifugal refrigerating machines of 750 hp. each, employing a refrigerant known as "Carrene." A dehumidifier, or spray chamber, in which the air is cooled and moisture removed, will be located adjacent to the refrigerating machines. It will be 50 ft. long by 16 ft. high and will use 8,400 gal. of spray water per minute. After passing through this dehumidifier the air will enter two great fans or blowers, from which it will be discharged into the mine shaft through an underground tunnel entering the mine about 100 ft. below the surface. A total of more than 3,000 hp. in pumps, motors and electrical control apparatus will be used in the installation. The economic significance of the project lies in the increased production of gold which engineers claim will result from extending the depth of present operations.

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Electric Controller Shows Net Profit of $53,570

Report of the Electric Controller & Manufacturing Company for the six months ended June 30 shows net profit of $53,570 after depreciation, federal taxes, etc., equal to 75 cents a share on 70,855 no-par shares of capital stock, comparing with net loss of $109,628 in the first six months of 1933.

New York Metal Prices

	Aug. 14, 1934 Cents per Pound	Aug. 21, 1934 Cents per Pound
Copper, electrolytic	9.00*	9.00*
Lead, Am. S. & R. Price	3.75	3.75
Antimony	8.75	8.62
Nickel ingot	35.00	35.00
Zinc, spot	4.65	4.62
Tin, Straits	52.90	52.00
Aluminum, 99 per cent	23.30	23.30

*Blue Eagle.

SALES OPPORTUNITIES IN NEW CONSTRUCTION

Spot coverage of the week. Projects approved and proposed, bids requested, equipment wanted, funds available. Prospects for the electrical manufacturer.

Fallston, N. C. — Southern Public Utilities Company, Charlotte, plans extensions in transmission line from Fallston to Toluca, Casar and vicinity for light and power service.

Summitville, Colo.—Summitville Consolidated Mines, Inc., plans complete electrification of new ore-treating mill at local gold mining properties, with installation of transformers and accessories, motors and controls, conveyors, etc. Mill will be equipped to handle about 100 tons crude oil per day. Cost over $85,000. Power service will be furnished by Public Service Company of Colorado, Denver, which has authorized construction of new transmission line from Alamosa, Colo., to Summitville for this purpose.

Annapolis, Md.—Bureau of Yards and Docks, Navy Department, Washington, D. C., asks bids until August 29 for power and lighting distribution systems for six radio towers at High Power Radio Station, Annapolis; also for winches for antenna, etc. (Specification 7735).

Michigan City, Ind.—Department of Water Works asks bids until August 30 for transformers, switchboard, switching equipment, controllers, conduits, lighting equipment and fixtures, and miscellaneous apparatus for new waterworks station, for which bids will be opened at same time. Greeley & Hansen, 6 North Michigan Avenue, Chicago, Ill., consulting engineers.

Los Angeles, Calif.—Board of Water and Power Commissioners plans extensions and improvements in electric power system, including new power substation for distribution service, cost about $130,000; additions and improvements in present power substations and new equipment, $150,000; improvements in present 33,000-volt overhead transmission system, $10,000, and similar work in present overhead and underground low voltage systems, cost $60,000 and $45,000, respectively; new oil circuit breakers and accessories at industrial stations, $39,000.

Midland, Mich.—Dow Chemical Company plans installation of motors and controls, conveyors, etc., in new additions to plants at Midland and Bay City, Mich. Cost about $75,000.

Brooklyn, N. Y.—Signal Supply Officer, Army Base, asks bids until September 7 for ten motor-generators and 50 motor-generators and battery units (Circular 7); until September 14 for switchboard cable and three reels (Circular 10).

Indiana, Pa. — Pennsylvania Electric Company, Johnstown, Pa., plans rebuilding of Possum Glory power substation, Indiana, recently destroyed by fire. Loss over $75,000, with equipment.

Danville, Ill. — Construction Service, Veterans' Administration, Washington, D. C., asks bids until September 25 for electrical distribution system at institution at Danville.

Belle, W. Va. — E. I. duPont de Nemours & Company, Wilmington, Del., has approved plans for addition to plant at Belle for production of special agricultural-chemical products. Cost about $300,000, with equipment.

Monroe City, Mo. — Asks bids until August 28 for extensions and improvements in city-owned electric light and power plant, including Diesel engine units and accessory equipment. W. B. Rollins & Company, Railway Exchange Building, Kansas City, Mo., consulting engineers.

Kaukauna, Wis. — Plans new ornamental street-lighting system in downtown district. Cost about $40,000. Project authorized by Public Service Commission.

Ogden, Utah—Bureau of Reclamation, Denver, Colo., asks bids until September 4 for 72-in. and 60-in. welded plate steel penstock and outlet pipes for outlet works, Pine View Dam, near Ogden (Specification 585).

Los Angeles, Calif.—Water and Power Bureau asks bids until August 30 for 16 disconnecting switches for Boulder Dam transmission lines, to be outdoor type, 287,000-volt, motor gang operated, vertical break type for horizontal mounting (Specification 1484); until September 4 for 15 lightning arresters, with rating of 37.5 kw., for Mono Basin Project, Mono County (Specification 1482).

Cleveland, Ohio — Clifton Distilling Company, recently organized, care of John W. Little, Plymouth Building, architect, plans new plant. Cost about $60,000.

Jacksonville, Fla. — Will make early survey of city-owned electric light and power plant, and electrical distribution system to determine plans for extensions and improvements, including equipment installation. Fund of $12,000 authorized for survey.

McPherson, Kan. — Asks bids until September 5 for extensions and improvements in city-owned electric light and power plant. Burns & McDonnell Engineering Company, 107 West Linwood Boulevard, Kansas City, Mo., consulting engineer.

Kalamazoo, Mich.—Upjohn Company plans installation of motors and controls, regulators, conveyors, etc., in new multistory addition at drug and pharmaceutical plant. New power house will be built. Cost about $450,000. Albert Kahn, Inc., New Center Building, Detroit, Mich., is architect.

Hartford, Wis.—Soon takes bids for turbine unit for city-owned electric light and power plant. Jerry Donohue Engineering Company, Sheboygan, Wis., consulting engineer.

New York, N. Y.—New York Department of Docks, Pier A, North River, is arranging fund of about $90,000 for electrical installations in three new pier sheds at Piers Nos. 88, 90 and 92, North River. Elevator equipment is estimated to cost $172,000, and conveyors, $45,000. Appropriation of $4,275,000 has been made for complete project.

MEN OF THE INDUSTRY

L. O. Whitsell Again Heads California Commission

Leon O. Whitsell, member of the California State Railroad Commission since July, 1925, and president of that body in 1928, has again been elected to the presidency to succeed Clyde L. Seavey, who resigned August 15 to become a member of the Federal Power Com-

mission. Mr. Whitsell is a native of Iowa and prior to going to California practiced law in Idaho. Before being appointed to the Railroad Commission he was a member of the Orange County Board of Supervisors and president of the Orange County Chamber of Commerce.

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FORREST RAYMOND, superintendent of advertising of the San Diego Consolidated Gas & Electric Company, has been elected president of the San Diego Advertising Club.

NEWMAN JONES, a member of the legal staff of the Southern Sierras Power Company since 1912, has retired from that organization. C. N. PERKINS, a Los Angeles attorney, has been added to the legal staff of the company.

H. C. MCDANIEL, formerly connected with the Pacific Power & Light Company at The Dalles, Ore., is now connected with the Central Illinois Public Service Company at Springfield.

FRANK BARBER has been appointed western representative of the Whitney-Blake Company with offices in Chicago Mr. Barber is well known in the electrical industry, having been for many years active in electrical manufacturing and jobbing. In 1904 he entered the shipping department of Western Electric at Kansas City and was transferred to Oklahoma City, Salt Lake City, Dallas and finally to the New York general department. For several years he has occupied the position of merchandising production manager with the Graybar Electric Company.

HARVEY C. COUCH has resigned as a director of the Reconstruction Finance Corporation, effective September 1. Mr. Couch, who is president of the Arkansas Power & Light Company and of the Mississippi Power & Light Company, will return to his home in Arkansas. The resignation was made known at the White House through publication of letters in which President Roosevelt said he reluctantly consented to Mr. Couch's request to be relieved of further responsibility.

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C. A. Corney Made Chairman of Engineering Societies

Chester A. Corney, assistant superintendent of the electrical engineering department, Boston Edison Company, has been elected chairman of the Engineering Societies of New England, recently expanded from the Boston organization of like name to facilitate cooperation of local engineering interests through their society groups with the centralized body at 88 Tremont Street, Boston. George A. Montague of the Massachusetts Department of Public Works has been made vice-chairman; Frederick W. Bliss, General Electric Company, Boston, treasurer; H. K. Barrows, consulting engineer, Boston, second vice-chairman, and Irving E. Moultrop, chief engineer Boston Edison Companuy, executive committee member at large. Other members of the executive committee are Arthur D. Weston, Massachusetts Department of Health; Holcombe J. Brown, clerk; John P. Kobrock, New England Telephone & Telegraph Company, Boston, and L. F. Jackson, Linde Air Products Company, Boston.

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ELLIS L. REDDEN has resigned his position with the Delco Appliance Corporation to become associated with the General Appliance Corporation, New York, distributor in the metropolitan New York area for Delco-Heat products. Mr. Redden had been associated with Delco-Heat for two years. Previously he had served many years in the New York area as a retail sales manager of oil burner equipment.

JOHN HUNTER of St. Louis, Mo., has recently joined the Riley Stoker Corporation, Worcester, Mass., as advisory engineer. Mr. Hunter is well known to the trade, having been connected with marine engineering and power plant construction and operation for many years. He has been active in the affairs of the American Society of Mechanical Engineers, having acted as manager and vice-president and having served on a number of important engineering committees of that society.

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A. S. Tait Assumes New Executive Duties

Andrew S. Tait has been appointed general manager of the English Electric Company of Canada, Ltd., with headquarters at St. Catherines, Ont., and vice-president and general manager of the Canadian Crocker-Wheeler Company, Ltd., which is a subsidiary of the English Electric Company. In joining the English Electric Company he has severed connections with the Packard Electric Company, Ltd., of which he has been a director and district manager in Montreal since 1922.

Mr. Tait's early training was obtained in the employ of the Canadian General Electric Company, with which organization he remained until 1917. His last position was that of district engineer, and in that capacity he was in charge of many important power projects under

construction at the time. In 1917 he left the C. G. E. to become electrical engineer and assistant general master mechanic of the Canadian Car & Foundry Company, Ltd., and the Canadian Steel Foundries, Ltd., remaining with them until 1922, when he became associated with the Packard Electric Company. Born at Bath, England, he came to Canada with his parents in 1895 and was educated in Montreal.

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ARTHUR V. WHITE, consulting engineer with the Ontario Hydro-Electric Power Commission since 1921, has resigned. Mr. White has had a distinguished career. After an extensive experience in industrial plants, he entered the employ of the Federal Department of Public Works, and subse-

quently was consulting engineer with the Conservation Commission, during the time that body was in existence. Later, he was consulting engineer to the International Joint Commission, Lake of the Woods investigation. He is regarded as an authority on questions in connection with international waters, and on many occasions has represented Dominion and provincial governments before tribunals at Washington, Albany and other places where Canadian interests were involved.

OBITUARY

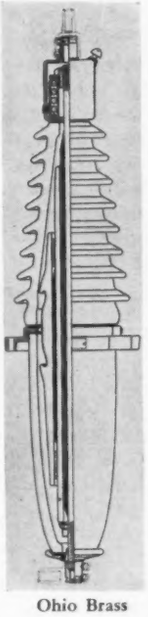
JOSHUA R. JOHNSON, who was associated with the pioneer development of the Thomson-Houston Electric Company at Lynn, Mass., prior to the organization of the General Electric Company, died at St. Petersburg, Fla., August 15. He was born in England 73 years ago and retired from business in 1930.

ALBERT M. WOOD, president-treasurer of Wood & Anderson Company, an electrical sales agency of St. Louis, Mo., died at his home in that city August 5. He was 86 years of age. In 1899 Mr. Wood was treasurer of the Western Electrical Supply Company, which later became the Wesco Supply Company, continuing with that organization until 1915. One year later he and his son organized the Wood & Anderson Company.

SVEN SVENNINGSON, chief engineer of the Shawinigan Water & Power Company and of the Shawinigan Engineering Company and vice-president and chief engineer of the Power Engineering Company, died at Bailey's Island, Me., August 16. He was 51 years of age. Mr. Svenningson was recognized as one of the outstanding hydro-electric engineers in Canada, where he had made his home for the past 21 years. Born in Oslo, Norway, he was educated at the Polytechnic Institute of Christiania and after obtaining two years' preliminary engineering practice in his native country he came to the United States. From 1909 to 1911 he was designer of the Pennsylvania Water & Power Company, Holtwood, and the three subsequent years he spent with the Fargo Engineering Company of Jackson, Mich., and with the Stone & Webster interests at Keokuk, Iowa. In 1913, transferring his interests to Canada, he joined the Cedar Rapids Manufacturing & Power Company, Montreal, two years later becoming designing engineer for the Shawinigan utility. It was in 1919 that he was appointed to the positions he held until his death. Mr. Svenningson was a member of the Engineering Institute of Canada and of the Professional Engineers of the Province of Quebec.

NEW EQUIPMENT

L-Type Oil-Filled Apparatus Bushings



Ohio Brass

Oil - filled apparatus bushings, known as class L, for voltages ranging from 69 kv. down to 7.5 kv., have been announced by the Ohio Brass Company, Mansfield, Ohio. These bushings, says the manufacturer, are designed to contribute to the refinement of low-voltage substation operation. They are filled with transil oil and incorporate all the major advantages of the large high-voltage O-B oil-filled bushings. In addition, the O-B practice of using porcelain to the maximum as the internal insulation is retained in this new line of bushings; also they are free from external or internal corona. In place of the cement flange assembly used in previous O-B bushings, the class L bushings are assembled in compression. Cement is not used to hold the outer parts together.

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"Tong Test" Ammeters for 800-Amp. Service

Ammeters for 800-amp. service without transformers are available from the Columbia Electric Manufacturing Company, 4519 Hamilton Avenue, Cleveland. Formerly this company's "Tong-Test" ammeters were for readings only up to 400 amp. The new size, however, are good only for either a.c. or d.c. and not both, as in the 400-amp. size. All instruments give readings, without interrupting the circuit, by closing the tongs around the conductor.

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Splash-Proof Motors

Splash-proof motors made with heavy solid cast frames and with special solid cast end bells, except for the fan-shaped air duct with openings at the bottom just slightly above the level of the motor feet, have been announced by Fairbanks-Morse & Company, Chicago. The air ducts in the end bells are provided with special removable, perforated baffles which protect the motor from water splashing directly into the air duct, yet provide unobstructed ventilation for the motor.

To protect the bearings against a high-pressure stream of water directed at them along the shaft a water deflector consisting of a simple ring around the shaft is supplied which can be easily removed if a pulley or coupling is installed adjacent to the bearing housing.

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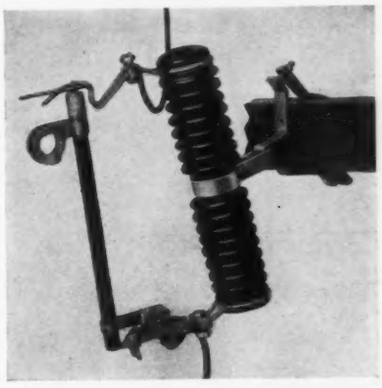
New Ratings of Open Fuse Cutouts

To complete its line of open fuse cutouts with drop-out fuse holders, so that suitable ratings may be chosen for all distribution circuits up to 15,000 volts, the General Electric Company has introduced three new units. These units, all of which can be fused from 1 to 100 amp., are rated at 5,000, 7,500/12,500 Y and 15,000 volts with an interrupting capacity of 2,000 amp. r.m.s. Two other units can be fused from 1 to 60 amp. at 7,500/12,500 Y and 15,000 volts with an interrupting capacity of 1,200 amp. r.m.s.

Fuse links can be quickly and easily



General Electric

installed and fuse holder tubes, made of weather-resistant vulcanized fiber over which is wound linen base textolite, can easily be replaced without renewing the metal parts of the fuse holder. The 100-amp. fuse holders are interchangeable, for the same voltage ratings, with the fuse holders used in the 60-amp. cutouts.

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SIGNAL AND CONTROL TRANSFORMERS the unit of which differs from existing control transformers in that it is composed of a two-pieced core, the outside having no butt joints, has been an-

nounced by the Sola Electric Company, Chicago. The inner core contains fixed shunts and in the assembly process the two cores are pressed together so as to obtain the maximum in uniformity, as well as ruggedness in construction. This type of core construction reduces the physical dimensions without sacrificing any efficiency, it is claimed.

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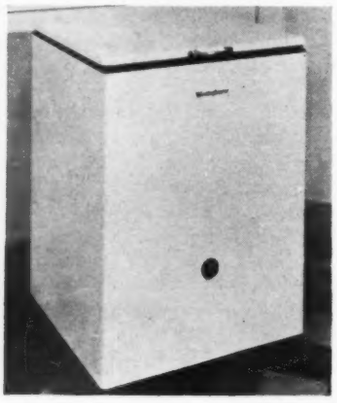
Chest Type Refrigerator

A chest type refrigerator of 2 cu.ft. capacity, model DC-20, having a hermetically sealed unit has been announced by the Westinghouse Electric & Manufacturing Company. It is particularly recommended as an auxiliary



Westinghouse

refrigerator for use in recreation rooms, pantries, small stores, etc. With $\frac{1}{8}$-hp. motor, the unit is directly controlled by a temperature selector located on the outside of the cabinet; $2\frac{1}{4}$ lb. of ice or twenty cubes can be made with a single freezing. The dimensions are 36 in. high and $22\frac{1}{8}$ in. wide with depth of $20\frac{1}{4}$ in.

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Metameter System for Telemetering

Long-distance transmitter and recorder operating on the well-known chrono-flo system has been announced by the Bristol Company, Waterbury, Conn. Adapted to Bristol's "Metameter," this system consists of a transmitter, a recording receiver, a relay and rectifier box at the receiver. With this system records of temperature, pressure, liquid level or motion may be transmitted 250 miles or more with extreme accuracy and with freedom from circuit disturbances, it is claimed.

A source of alternating current is required at both receiver and transmitter, but they need not be synchronized nor of the same frequency. The recording receiver uses a 12-in. chart and is housed in the new moisture rectangular model 40M case.

Automatic Welding Head

Accurate control of arc length with permanence of adjustment are features of the new automatic arc welding head of Una Welding, Inc., Cleveland, Ohio. Two independent motors work against each other through differential gearing to hold the arc adjustment. This eliminates resort to clutches or fine electrical contacts, instantaneous reversal of the welding wire not necessitating reversal of either motor. Speel control is simple and positive. Ample powering permits the use of very short arc lengths and allows the welding head to follow irregularities in the contour of the seam without danger of interrupting the arc. Full torque is available at all speeds for quick acceleration; dynamic braking is utilized for rapid deceleration.

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Explosion-Proof Switches

A line of explosion-proof safety switches for use in Class 1, Group D, hazardous locations has been announced by Cutler-Hammer, Inc., Milwaukee, Wis. This line includes both single-throw and double-throw types, in standard sizes up to 200 amp. capacity. The switch is a heavy, industrial duty type A construction, with outside operating handle, mounted in a heavy weather-proof, semi-steel cast inclosure. A precision machined flange of required width, between the case and cover, assures proper cooling of any flame which might occur from an explosion with the case, so that outside gases will not ignite. Corrosion-resisting bolts hold the cover firmly in place.

Two pipe-threaded conduit holes are provided in the bottom of the case and pads at the side and top of the case allow for drilling other holes if needed. Provision is made for padlocking the handle in either position—accommodates three padlocks in off and three padlocks in on positions to meet specific industry requirements such as in steel mills, etc.

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Lamp Cord With Zip Construction

Lamp cord with a novel zip construction that permits easy and safe opening of the sheath and separation of the conductors has been developed by the U. S. Rubber Company. "Zipcord" consists of two parallel conductors, rubber jacketed. When one pulls the conductors apart the rubber jacket divides evenly, assuring perfect insulation for each conductor.

Protected by thick walls of rubber compound, this lamp cord may be stripped down without danger of impairing the dielectric properties of the individual conductors. It has been approved by Underwriters' Laboratories, Inc.

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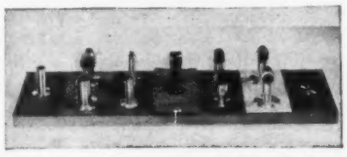
Modernistic Outlets for Underfloor Duct

Designed to harmonize with the modern trend in office furnishings, a complete line of modernistic surface fittings or outlets for underfloor duct has been announced by the General Electric Company, Bridgeport, Conn. The line includes duplex two-pole, three-pole, twist-lock and polarity outlets. A special



General Electric

flange for use with carpets is designed so that it may be easily installed, without injury to the fabric, merely by separating the nap. The outlets are available with either textolite or brass-housed heads.

ENGINEERING DATA FROM MANUFACTURERS

Bulletins and catalogues now available to engineers by manufacturers and associations.

Bulletin No. 100 of American Steel & Wire Company (Room 1404, 208 South LaSalle Street, Chicago) is just out with the title **Concentric Armored Service Entrance and Service Drop Cable.** It describes the make-up and use of the new AEIC type and gives the current rating, diameters, weights and shipping lengths of the two- and three-conductor assemblies with one bare concentric conductor. Concentric service drop cable Type CU is approved for use in conduit or on insulators.

Maintenance of Reciprocating Parts is a new pamphlet by the Linde Air Products Company, 30 East 42d Street, New York, of value to repair staffs. It shows specifically how such worn and deformed parts as bull-rings, pistons and rotary exhaust valves can be rehabilitated by oxyacetylene welding and bronze resurfacing.

Electric Instruments is a new catalogue (GEA-602D) of General Electric Company which in its 162 pages lists the standard line of switchboard, portable and laboratory instruments. Ranges, list prices and mounting dimensions are given, along with performance data and burdens and suggestions for advantageous uses with or without test accessories and adapters available. Oscillographs, potentiometers, recorders, totalizers and magnetic apparatus are included.